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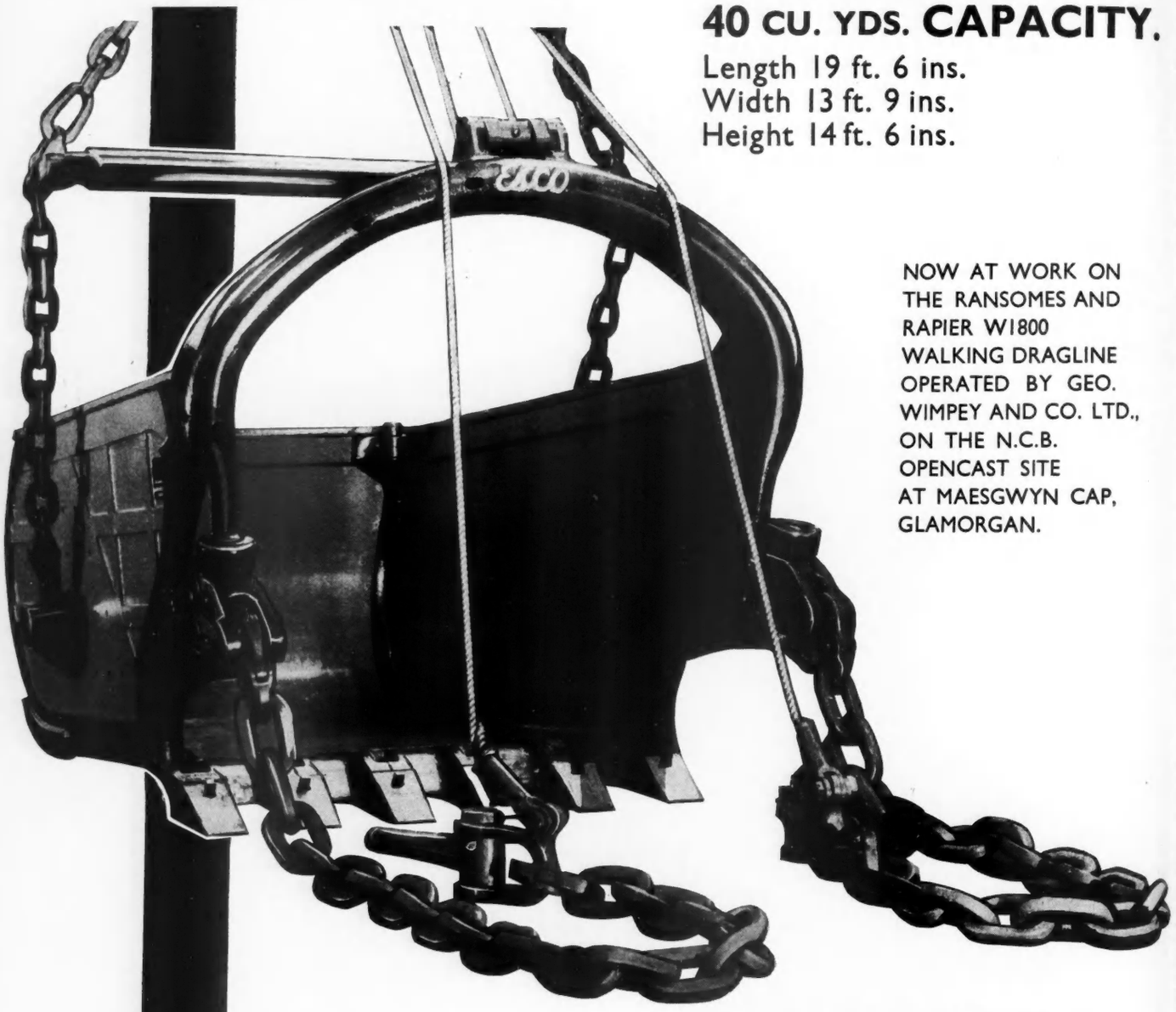

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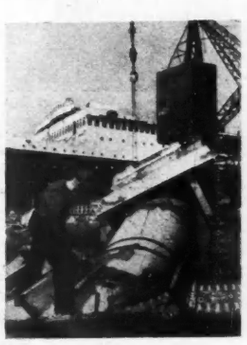

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A shipbreaker cutting up a ship's section, taken from the M.V. "Britannic." (*Nurnberg photograph for* ENGINEERING)

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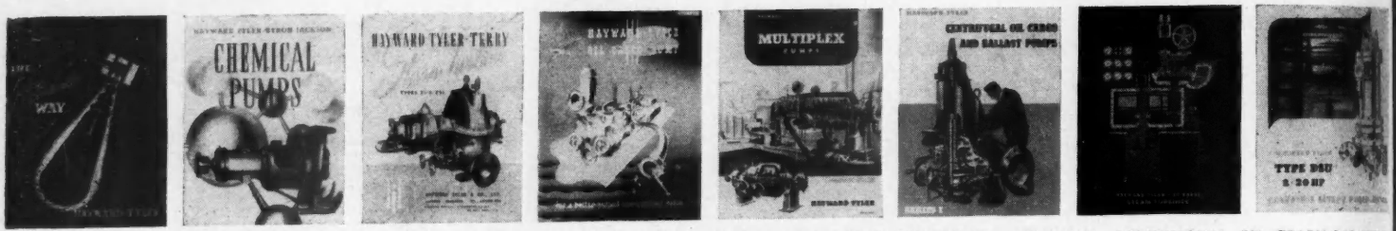

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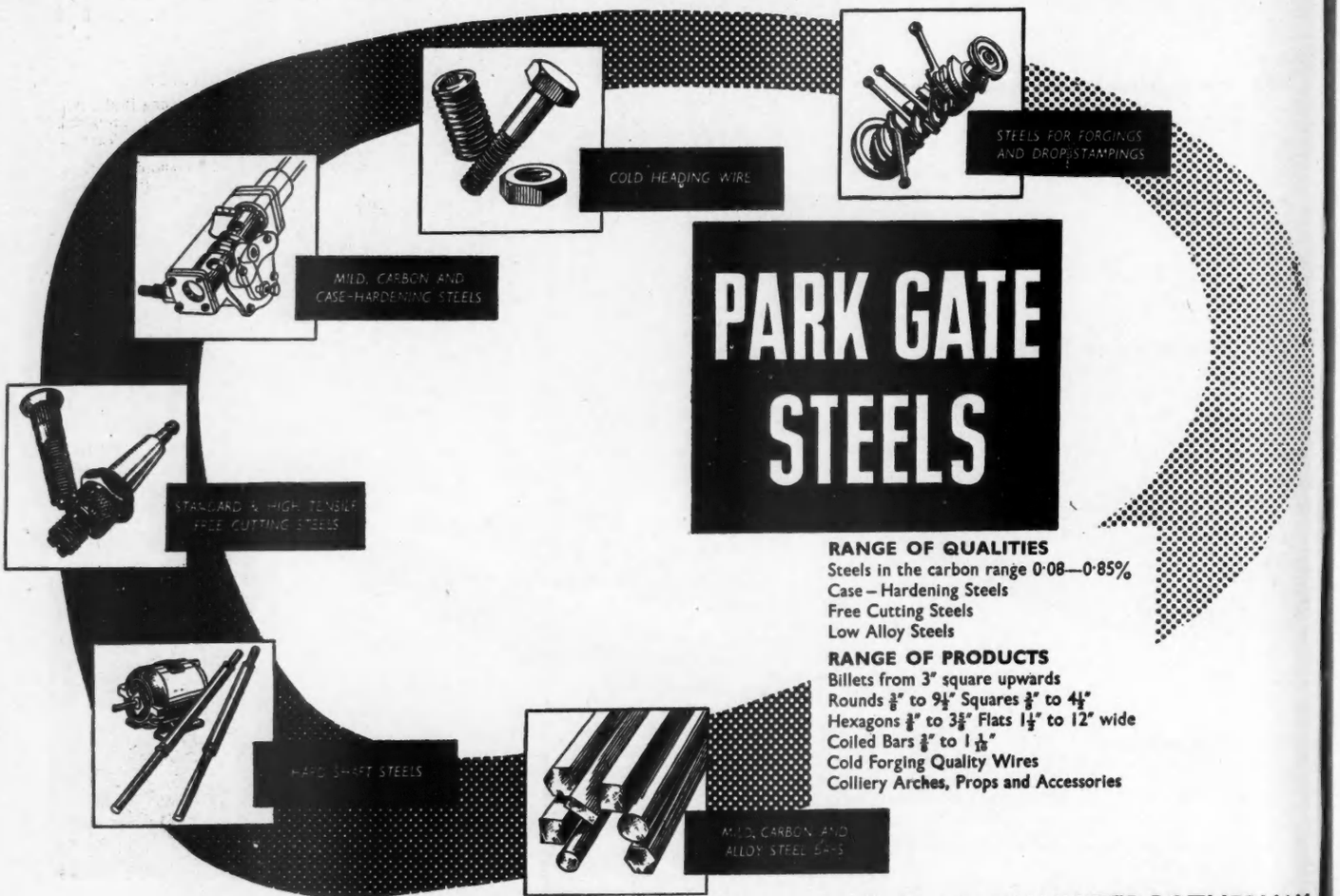
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ENGINEERING Impact

of Radio and Electronic Engineers

When Lord Mountbatten of Burma, as President of the British Institution of Radio Engineers, addressed the annual dinner of the radio and electronics industry last week, he suggested that the time had come to investigate the possibility of establishing a radio and electronics research association. This, he felt, might give new unity and strength to the sectional and sometimes overlapping research carried out in different parts of the industry.

Four months ago the British Institution of Radio Engineers were granted a Royal Charter of Incorporation, and it was suggested in these columns at the time (ENGNG., 11 Aug. '61, p. 161) that with the growth in the electronics interests of the Institution, it might be desirable to change the Institution's name. Lord Mountbatten's proposal re-emphasizes the trend towards specialization in engineering which continues even while some of the senior institutions explore the possibilities of some form of closer integration.

The research association movement has gained tremendous impetus since the war, largely guided by the Department of Scientific and Industrial Research. These associations now range widely through industry, from the large organizations like the British Iron and Steel Research Association and the Production Engineering Research Association to the newcomers like the Machine Tool Research Association which is now in process of setting up shop. It seems reasonable to assume that what associations of this sort have done for other industries, they could also do for the radio and electronics industry—always with the proviso that some duplication of research can sometimes guard against the wrong conclusions being reached too soon.

Lord Mountbatten also emphasized the importance of research into reliability, and gave the staggering information that a recent survey in the USA had shown that present electronic equipment costs more than ten times (and sometimes 100 times) as much to maintain throughout its lifetime as its capital cost, including the cost of research and development. This would seem to be a cue for Britain's newly-formed National Council for Reliability and Quality.

Control of London

The Government's proposal to revolutionize the local government of Greater London will affect the provision of a wide range of engineering services in the Metropolis.

Greater London comprises over 100 local authorities loosely linked and each with its own interests at heart. The Government's proposals for reorganization, as now presented to Parliament, are for a central body—the Greater London Council—capable of coordinating mains services, while at the same time leaving much of the purely local work to 52 newly formed boroughs averaging 200,000 inhabitants. In the main the new boroughs would be formed by the amalgamation of existing ones, leaving the boundaries unaltered as far as possible.

Social services would have to undergo some reorganization and so would the engineering services, both probably to their advantage. Following the lines of the Commission which reported last year, the proposals are to place all main roads in the control of the Council leaving other roads to local authorities. Such a scheme would allow a global plan for through traffic to be put in operation: "to face the new problems presented by changing social conditions and the ubiquitous motor vehicle."

"The authority to deal with the planning, traffic and road problems of Greater London must exercise a real responsibility." "Hitherto London has suffered from . . . too great proliferation of not very strong authorities" are quotations from the White Paper. Main sewerage and sewage disposal are other engineering works that would profit from central control.

A single body can ensure that main through roads are adequately lighted and do not have sudden changes from sodium yellow to mercury blue. Some of these main roads would later be considered as possible trunk roads coming under the Minister of Transport and so be knit into the road system of the country as a whole. This could be the beginning of a unified standard of lighting, width, and surfacing for all trunk roads in the country.

Too Few Spaces for Cars

Car parking is a national problem. Simple observation shows this to be true, but the survey by the Roads Campaign Council shows that surprisingly few data have been assembled by municipal authorities to assess the need in their areas. This despite the fact that the central Government have been quite emphatic that it is a local government matter and that there will be no Treasury grant to help solve the problem.

The Campaign Council's inquiry concerned only private cars. They approached 419 authorities and had replies from over 300. It was found that an average cost of building off-street parking, excluding land purchase, was £300 per vehicle space. It was also found that the proposed expenditure over the whole country next year on car-parking facilities amounted to only £3,000,000—or 10,000 places. This figure, the Council point out, is equal to the number of additional cars coming on to the roads every 6½ days. The next step is for the councils to determine the need in their territories, estimate the cost of providing the car parks and calculate an equable charge. Local Chambers of Commerce should not overlook the fact that, like improved thoroughfares, better car parks will undoubtedly attract cars—and business.

Though the Road Campaign Council's inquiry was not concerned with commercial vehicles, the Traders' Road Transport Association, who represent the C licence operators, have taken up this aspect of the parking problem. They have addressed their inquiry to 1,288 highway and traffic authorities in Britain. The association want to know what provision is being made for off-street loading and unloading, and whether any standard or specification has been laid down for off-street loading facilities in relation to new development. The TRTA subscribe to the view—now widely held—that the only long-term solution to the traffic problem lies in the segregation of the various functions which the urban roads have to perform. Internal loading bays, along with basement car parks, seem essential provisions for all buildings in central areas.

Even at this late moment buildings are still going up deficient in facilities for off-street loading: inadequate headroom and absence of turning space are the most common faults.

Nuclear Merchantman over the Horizon

Within three weeks of the Government announcing their authorization of a vigorous research programme to find a reactor system economically attractive to a wide range of shipping, a new working group has been formed to advise the Minister for Transport and the Minister for Science. The group's terms of reference are "to advise and make recommendations on the programme of research required to advance nuclear propulsion for merchant ships."

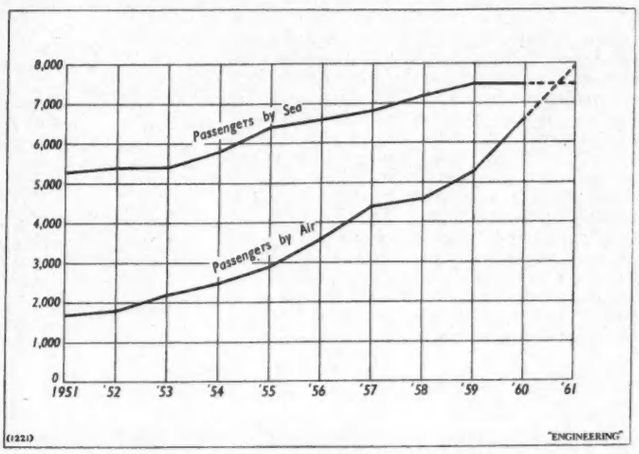
One of the members of the group is Sir William Cook, the development and engineering member of the Atomic Energy Authority. Sir William gave his views on ships' reactors at the James Watt dinner of the Institution of Engineers and Shipbuilders in Scotland. Technically, he said, there was no difficulty. Economically, there was not a suitable reactor in sight. Even for the largest size of ship envisaged, the reactor-propelled ship would have an overall cost 10 to 15 per cent higher than the conventional vessel. The best prospect was the 65,000 ton tanker, and for a suitable reactor it would be necessary to cut the capital cost of the reactor to a half and the fuel cost by a third. He implied that he thought it could be done. In addition, however, he pointed out that the cost of the biological shield would have to be reduced, and instrumentation would have "to be given a new look."

How far out of sight the suitable reactor is was suggested by Dr. Joseph Richards, of the British Shipbuilding Research Association, when he gave a paper to the Institute of Marine Engineers at the end of last month. He described a high temperature reactor using plutonium as the fuel. Its cost he put at £600,000, roughly half the figure given in last year's tenders from the consortia for a merchant ship reactor: unfortunately, although this meets Sir William's cost-cutting factor of two, Dr. Richards' reactor is still only a design study evolved on a computer—the ironmongery has yet to be built. Nevertheless, the new working group now has a reactor system to study and, surely, a good recommendation from the group in due time will enable the Government to cut the price of the plutonium by the requisite third.

The group is not going to make a formal report. It will advise the two Ministers concerned as developments warrant, and the research programme will be carried out by the Atomic Energy Authority in conjunction with industry.

Air Travellers Exceeding Sea Travellers

Four years ago the number of passengers carried across the North Atlantic by air exceeded the number carried by ships for the first time. Another significant cross-over point is almost certain to be revealed when the 1961 figures are available for the movement of passengers into and out of the United Kingdom by sea or by air. The graph shows the changes that took place during the ten years 1951 to 1960.



Total movement of passengers into and out of the United Kingdom: cross-over point this year?

Virtually all the increase in international travel is going to the airlines while the volume of the shipping companies' share remains more or less constant. Ship speeds, too, remain more or less constant while air speeds increase sharply. A slackening in the rate of increase in passengers by air this year, coupled with over-investment in new jet airliners by world airlines, has depressed the load factor and presented the airlines with serious financial problems, but their traffic will undoubtedly continue to increase. World population is increasing, too, and will probably double over the second half of the 20th century.

The Growth of Hydraulics in Agriculture

The close proximity of a conference at the Institution of Mechanical Engineers on oil hydraulic power transmission and control, and the Royal Smithfield Show, offers a suitable occasion to review the contribution of hydraulics to power farming.

FARMERS have always been accused of the utmost conservatism in accepting new ideas, but it is significant to note that hydraulic actuation is fully accepted by farmers throughout the world as a reliable, efficient and versatile means of transmitting power.

The introduction of hydraulics to the agricultural tractor has doubtless assisted the transformation of the tractor from a replacement for the horse into a versatile, mobile tool-carrier and power source. The combine harvester also owes much to hydraulics, not for improving the grain separation, but for making control of the harvesting mechanism simple and easy to handle, thereby increasing the efficiency of the machine particularly when picking up crops which have been laid by storm damage.

Combine Harvesters

Present-day combines use hydraulics primarily for three services; table lift, reel lift and traction control. The third service is speed control, which is given by the hydraulic actuation of a variable pulley system. It is possible that additional services will be included as development continues. Such things as rotation of the reel by hydraulic motor, operation of the cutter bar and speed control of the drum are all applications which would lend themselves to hydraulic actuation and would eliminate many of the chains and pulleys which are at present used. The object is to offer either better control at little or no extra cost, or similar control at a reduced cost, reliability being of the utmost importance.

The focal point of the tractor's versatility as a piece of farm machinery is the three-point linkage with hydraulic lift. Of all the uses for the three-point linkage the one which presents the most problems to the hydraulic engineer is ploughing at constant depth or constant draw bar pull, and to achieve this with the maximum amount of weight transfer on the rear wheels, thus minimizing wheel slip.

Tractors

The illustration on this page shows the inbuilt hydraulics as used on the Fordson Super Major. Operating at a pressure of 2,500 lb per sq. in, this system is used to actuate the conventional three-point linkage in either positional control or draught control, using a single-acting inbuilt ram. Power is obtained from the PTO driven gear pump delivering 3 to 5 gal per min at nominal engine speed and mounted in a special hydraulic compartment with a capacity of approximately 5 gal. Care has been taken that the minimum amount of aeration occurs during operation by shrouding of the gears in this chamber. The oil is filtered by a gauze strainer and a magnetic plug at the pump inlet, and by a paper type bypass filter on the return line. An unloading type safety valve is used to protect the system and ensures not only that the maximum design pressure is not exceeded, but also that prolonged power wastage, with all the associated difficulties of rapid rise in temperature, is not possible.

The fluid from the pump is first passed to a manually operated bypass control valve, enabling the driver to select a given flow rate which is independent of the pump output, so that the response rate of the hydraulic system can be pre-selected. An override control is incorporated by mechanical linkage to the control lever, so that on selection of "fully raise" the maximum pump output is employed. This feature is necessary when ploughing and using a slow rate of response, so that on the headland turn the plough will leave the ground quickly and without affecting tractor manoeuvrability.

Control, either positional or draught, is obtained by using a three-land control spool coupled to a single control lever with feed back from either a cam fixed to the cross shaft of the lift arms, or the turning moment of the implement being towed, compressing a large spring in the top linkage.

The control spool is designed to operate the shuttle type selector valve in the "raise" position so that in this case very little metering can be obtained. Metering slots are machined in the shuttle valve to reduce the effect of overshoot pressures on rapid selection. On lowering, the full flow from the ram is passed through the control valve to the tank, so that the rate of lowering is controlled by input signal. Weight transfer to the rear wheels, which is dependent on pressure being maintained in the ram, is obtained by the overall restriction in the oilways and the spool at full or partial selection of "lower."

At the recent conference on Oil Hydraulic Power Transmission and Control held at the Institution of Mechanical Engineers, Mr. F. D. Taylor presented a paper on which this article is based. In it, he said that the trend will be for more implements to be developed using the inbuilt hydraulics as a source of power instead of using mechanical drive from the PTO. If rotary motion is required, gear motors will be used. This will inevitably simplify implement design and make the coupling of the implement to the tractor much easier—forage harvesters and post hole drills being typical examples.

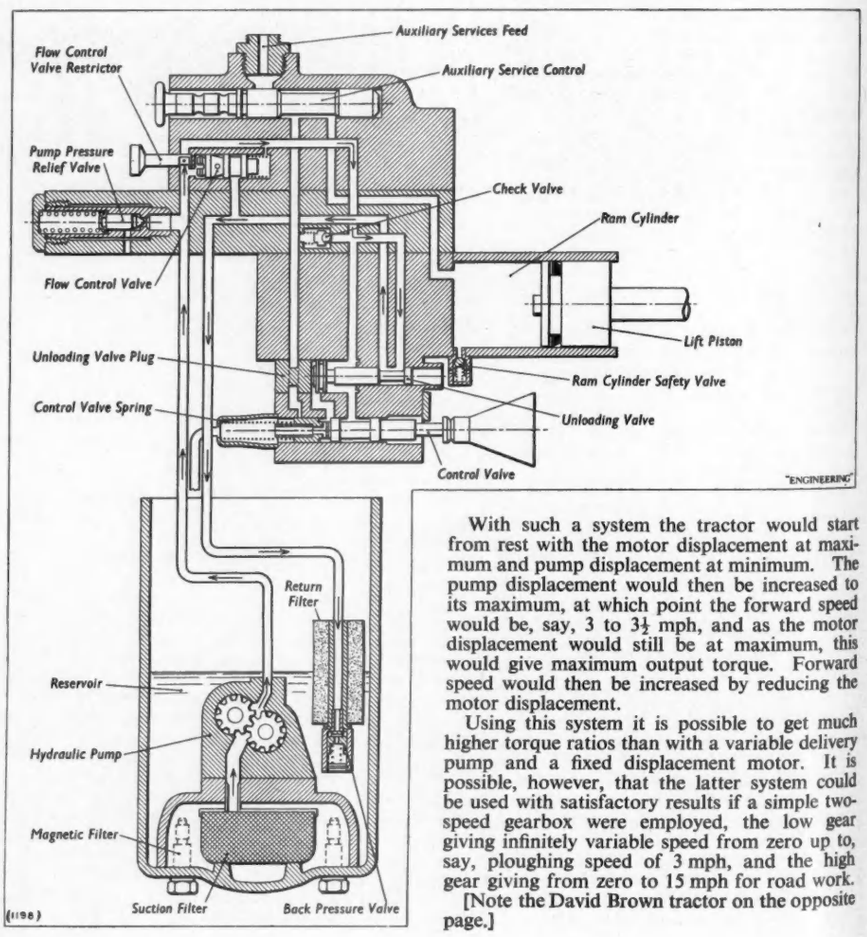
Much development has been done on hydraulic components. Pressures have gradually increased to the present 2,500 lb per sq. in system pressure which is standard in Great Britain. The gear pump has been established in this field, and has been proved a reliable and efficient unit working sometimes under arduous conditions.

Although gear pumps are widely used at present, it is thought that pressures will increase over the next, say, 10 years to possibly 5,000 lb per sq. in, and that the variable delivery piston pump will eventually take its place. The advantages of such a pump would be considerable. Ploughing, for instance, is sometimes carried out under conditions which demand fluid at the rate of no more than ½ gal per min, although the number of corrections required is so great that the pump is on load for as much as 80 per cent of the time. During such conditions as much as 2½ hp is being wasted and transferred to heat. The increase in system pressures will only take place, however, as the reliability of equipment is proved.

Hydrostatic Transmissions

The author thought that the introduction of hydrostatic transmissions for tractors was inevitable. The advantages are well known, but the point which has yet to be decided is what form the transmission will take. The most promising solution so far appears to be a system using a variable delivery pump and a variable delivery motor back to back.

Inbuilt hydraulics system as used on the Fordson Super Major tractor.



With such a system the tractor would start from rest with the motor displacement at maximum and pump displacement at minimum. The pump displacement would then be increased to its maximum, at which point the forward speed would be, say, 3 to 3½ mph, and as the motor displacement would still be at maximum, this would give maximum output torque. Forward speed would then be increased by reducing the motor displacement.

Using this system it is possible to get much higher torque ratios than with a variable delivery pump and a fixed displacement motor. It is possible, however, that the latter system could be used with satisfactory results if a simple two-speed gearbox were employed, the low gear giving infinitely variable speed from zero up to, say, ploughing speed of 3 mph, and the high gear giving from zero to 15 mph for road work.

[Note the David Brown tractor on the opposite page.]

Tractor with Automatic Transmission in Production

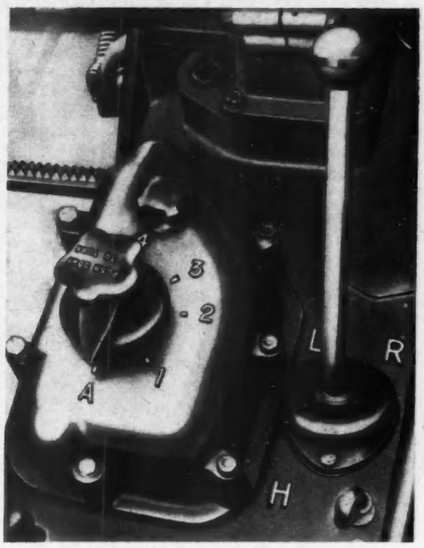
David Brown Tractors have introduced a tractor with a simple form of automatic transmission, partly hydraulic but predominantly mechanical.

Known as the "Autodrive," it is built into a standard 52 bhp David Brown 990 tractor. The transmission has two forward speed ranges—one giving 4 to 16 mph for light transport and road work, and the other providing speeds of 1 to 6 mph for specialist jobs such as harvesting and cultivating. A further range of reverse speeds is also available.

Although the company have not released details of the drive's construction, it appears that they have overcome the main difficulty of how to sustain power to the tractor's rear wheels during speed changes in heavy work like ploughing. At such time, even momentary interruption of the power drive is sufficient to bring the tractor and plough to an immediate halt.

Whilst most experts have assumed that some form of hydrostatic or hydrokinetic transmission was the only answer, David Brown point out that either of these systems would entail a radical departure from standard tractor design. Apart from inherent drawbacks such as high fuel consumption and the need to evolve new complex operational and servicing techniques, the company say that such a tractor would be beyond the pocket of the average farmer. As it is, the price of the 990 Autodrive tractor complete with "live" power take-off and hydraulics will be under £900 in the United Kingdom.

On the "Autodrive" tractor the dial pointer is set to effect automatic changes of transmission ratio; set in any one of the four speeds it would give over-riding manual control. The conventional gear lever selects high, low or reverse speed ranges.



When the tractor was demonstrated to a representative of ENGINEERING, it appeared to be easy to drive. Variations in load are met by automatic speed changes: when ploughing on undulating land, for example, the Autodrive moves automatically into higher speed on downgrades and into lower speed on upgrades. The driver is thus free to concentrate on the job in hand without having to worry about gear changes.

Gear changing on the move is practically impossible on most tractors and David Brown estimate that here alone the Autodrive will improve tractor efficiency and productivity by between 10 and 15 per cent. Alleviation of driver fatigue, and constant working at the most efficient speed are added benefits.

To operate the tractor the driver simply sets a dial to "A" for automatic and then engages the selected speed range. The Autodrive system selects the lowest speed ratio on starting from rest—thereby minimizing the load on the transmission—and then changes smoothly, automatically and without pausing, to the highest and most efficient working speed possible according to the load and ground conditions.

David Brown Tractors Limited, Meltham, Huddersfield, Yorks.

Improving Future Ships by Trials on New Liner

When the 33,000 ton liner "Transvaal Castle" has her trials this month she will carrry several research workers from the British Shipbuilding Research Association. They hope to obtain information which will help advance the design of future ships.

Built and engined by John Brown and Company for the Union Castle line, the BSRA programme includes vibration tests as well as an extensive examination of the factors affecting performance. Though some of the vibration observations will be made by the staff of the builders, all the data will go into BSRA's pool of technical information. The performance results will be correlated with data obtained by the National Physical Laboratory from tank tests with models of the hull form, which is of the builder's own design.

Avoidance of vibration is of particular importance in passenger ships and this has called for increasing attention in large multi-screw vessels as higher powers have been employed. Apart from the obvious discomfort to those on board, excessive vibration could lead to structural fatigue. The work of BSRA in this field has already borne fruit in recent designs.

On the Transvaal Castle, particular attention will be paid to the propeller bossings and to the seatings of the thrust blocks which transmit the thrust from the propellers to the hull. Various instruments will be fitted in the dry dock.

In addition to BSRA investigations, special instrumentation has been arranged on the main machinery to enable a complete vibration analysis to be carried out. The research department of Lloyd's Register of Shipping is to investigate the movement of turbines and gearing, and will take strain gauge readings of the stresses in the gearwheel spindle.

Two torsionmeters of improved design will be used. They have a light alloy husk in place of the usual cast iron, resulting in a 30 per cent reduction in the inertia of the instrument; this is expected to lead to further improvements in the accuracy of power measurement.

British Shipbuilding Research Association, Prince Consort House, 27/29 Albert Embankment, London SE1.

Hovercar Project with Linear Electric Motor

Design work on a development of the hovercraft in the form of a Hovercar has been started by Hovercraft Development Limited at their base at Hythe near Southampton. The project is being led by Mr. Christopher Cockerell, inventor of the Hovercraft.

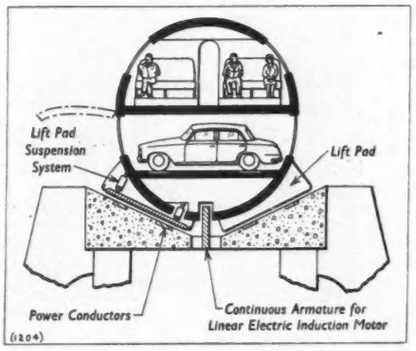
Operating on the same principle, the Hovercar would have a suspension system and lift pads on its underside. The pads employ jets to generate and sustain the air cushions which support the vehicle about half an inch above a specially prepared track.

The particular design being worked on is for a 43 ton craft, costing some £150,000, to carry 150 passengers at speeds up to 300 mph. As such it could be used for fast non-stop passenger services between city centres.

At slower speeds and with an increased passenger load such craft could form underground trains and cars could be linked together. They could also form the transport used for the Channel link, be it tunnel or bridge. A wide range of designs is practicable, covering small 50-seat passenger cars to large double-deck vehicles for several hundred passengers or an equivalent load of cars or freight.

At Manchester University, experiments are being carried out under Dr. Eric Laithwaite in the Electrical Engineering Department, to find a suitable type of propulsion for the Hovercar. They are working on the linear electric induction motor which appears to be a form of motive power particularly suitable for the Hovercar and the speed range so far visualized. While other forms of propulsion such as air propellers may be considered in certain circumstances, the linear electric induction motor has the added advantage of having no moving parts, quiet operation and no disturbance of air.

To control and guide the Hovercar a suitable track arrangement has been designed. One method is in the form of a shallow V. Because the vehicle is normally not in contact with the track, maintenance costs on the vehicle and the track itself will be reduced to the minimum. The necessity for tunnels and cuttings would be reduced because it is said that the Hovercar could cope with relatively steep gradients.



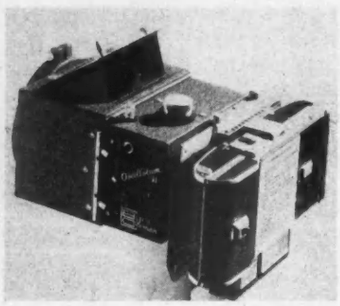
Cross section through a Hovercar designed to carry both passengers and freight on two decks.

The first result of the work being carried out at Hythe could be the operation of a small manned vehicle on an experimental track.

Versatile Oscilloscope Camera

A one-camera system to serve all requirements for oscilloscope photography is provided by the Beattie-Coleman Mark II Oscillotron. It is said to be the first oscilloscope camera with a built-in object-to-image ratio change system.

Not only can the ratio be easily changed from 1:1 to 1:05, without any special lenses or parts but up to 13 exposures can be made on a single film by using the Beattie-Coleman positioning bar. Completely distortion-free photographs are



Claimed to be the first oscilloscope camera with a built-in object-to-image ratio change system.

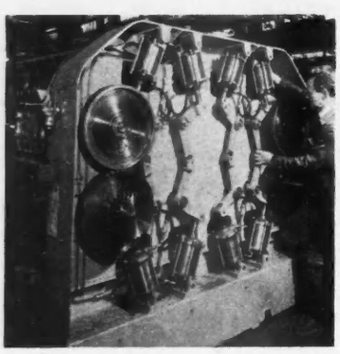
assured because only the film back moves. A choice of camera backs is available: Polaroid R back uses both 300 speed film and Polaroid transparencies, while an alternate back accepts 4 in by 5 in cut film, film pack, Polaroid R packet, glass plate holder and 120 roll film.

Said to be simple in operation, the Mark II provides sharp, accurate photographs of oscilloscope traces and can record nanosecond (10^{-9} secs) signals. Versatility is obtained through a combination of features which include the ability to take any 5 in oscilloscope, a direct-view aperture, a light which indicates that the shutter is open, external focusing, data-recording through a separate optical system, electrical connector and a dark slide to permit removal of film without fogging.

Ad. Auriema-Europe, SA, 172A Rue Brogniez, Brussels, 7, Belgium.

Machine for Hauling-Off Plastic Extrusions

The machine shown in the accompanying illustration is one of Fawcett Preston and Company's complete range of rubber and



This machine hauls-off cable from the extrusion plant.

plastic extrusion equipment manufactured under licence.

This machine is designed for hauling rubber or plastic covered cables and sections between the extruder and take-up drum. It is done by twin opposed crawler tracks comprising replaceable rubber pads mounted on chains which are synchronized through the helical gears seen in the photograph.

Drive units, depending on the duty of the machine, consist of a 2½ to 10 hp variable speed motor, a 4 or 6-speed gearbox and a worm and wheel reduction gear. The drive is transmitted to the crawler track by a Duplex chain and a maximum operational speed of 500 ft per min. is obtainable. Pulling capacity is variable up to 5,000 lb and several units can be used in line to give increased hauling power.

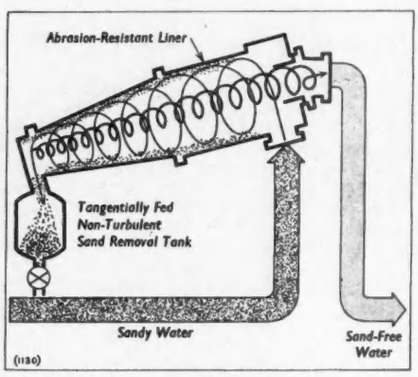
The treads on the crawler tracks are adjustable for diameters or sections between 0·312 in and 5 in. They are pressed into contact with the product by two pairs of ductile iron shoes specially designed to prevent scuffing. Each pair of shoes is linked together by levers and operated by four air cylinders so that a common centreline is maintained, the treads automatically following any variations in diameter. At each end of the machine is a set of adjustable vertical and horizontal guide rolls which ensure that the cable is fed into the centre of the treads.

Fawcett Preston and Company Limited, Bromborough, Cheshire.

Centrifugal Separator Has no Moving Parts

Now available in Britain, is a centrifugal separator designed especially for removing fine sand, scale and similar materials from water, and it could be used for such things as the removal of mill scale from cooling water in steelworks.

With no moving parts, the Krebs sand separator derives its energy from the main circuit



Although basically similar to an hydraulic cyclone, this separator has an important difference in that the apex discharge is under pressure.

pumps. Particle-laden water is injected into the cylindrical chamber where it is subjected to a vortex developing high angular velocities. As the water spirals inward toward the vortex finder, very high centrifugal forces act on the particles to force rapidly them toward the wall of the cylinder. Once these particles have been centrifuged to the cylinder wall, they progress by a downward spiralling action toward the apex of the cone and are finally discharged through a tangential orifice into the accumulator tank.

The involute feed helps in pre-classifying particles before entering the cylindrical section. Such an arrangement means that most of the particles enter the cylinder with a smooth flow pattern along the wall, thus minimizing the solids-induced turbulence and ricochet action that is found in straight tangentially fed cyclones. Efficiency of removal of solids is given as often better than 97 per cent.

A feature of the Krebs separator is the method of discharging and collecting particles after separation. Because of a simple tangential departure from the area near the apex, little energy is transferred from the high velocity angular motion of the water in the cone to the contents of the particle accumulator tank. Consequently, a particle experiencing high angular velocity at the apex can be discharged into a slower moving straightline water stream and this has a negligible effect on the contents of the accumulator tank. By eliminating the cylonic swirl in the accumulator tank it is possible to retain substantially more of the fine particles discharged into it, and the absence of violent swirling eliminates abrasive wear.

Standard sizes have capacities from 50 to 1,600 gal per min and larger sizes can be built to order.

Neldco Processes Limited, Crossway House, Bracknell, Berks.

Mobile Gas-Turbine Compressor Unit

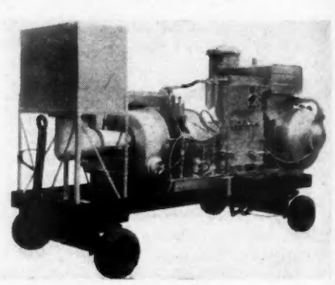
A portable air power unit combining an Auto Diesels gas-turbine and a Broomwade rotary oil-cooled compressor has been developed to fill the need for a compact and reliable standby and emergency compressor for use in oil refineries and similar applications. The weight is given as 3 tons.

The prime mover was designed to incorporate the advantages of the power-to-weight ratio of the aircraft type gas-turbine as far as practicable with the robustness of the industrial type. Known as the STAD model 1S/250, it is a single shaft all radial flow model, having a continuous rating of 220 bhp at 24,000 rpm. The output shaft speed is reduced to between 8,000 and 1,500 rpm. The relatively low speed of the compressor/turbine rotor shaft allows the drive to be through a simple helical spur reduction gearbox as opposed to the epicyclic gearbox that is required to give the same reduction with an aircraft type turbine running at speeds between 30,000 and 50,000 rpm.

Integral machined compressor and turbine rotors result in the minimum of damage should any foreign bodies enter the air intake.

The compressor is a Broomwade WR630, two-stage rotary model having an output of 630 cu. ft of free air per min at a pressure of 100 lb per sq. in at 1,650 rpm. The high pressure and low pressure rotors are mounted side by side in a common stator housing. The lp rotor is driven by the turbine, with a geared drive to the hp rotor, providing a first stage compression of about 30 lb per sq. in and a final delivery at 100 lb per sq. in.

The amount of air delivered by the plant is regulated by a combination of turbine speed reduction and air intake volume control from full to zero capacity. The output controller, operated by the air receiver pressure, regulates



Auto Diesels and Broomwade combine to make this gas-turbine compressor unit.

the turbine speed to suit the air demand down to half capacity. Should the air demand still fall, the control valve on the lp inlet is automatically closed so that no further compression can take place until the receiver pressure has fallen by a further predetermined amount, permitting the valve to re-open.

Auto Diesels are also offering a 174 kVA generating unit powered by the same gas-turbine.

Auto Diesels Limited, Braby House, Smithfield Street, London EC1, and Broom and Wade Limited, High Wycombe, Buckinghamshire.

The Re-built "Bluebird" Nears Completion

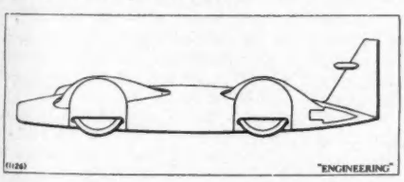
Contributions to the reconstruction of Bluebird have come from 84 British firms and a second attempt on the world's land speed record by the car is scheduled for the Spring of next year. Lake Eyre in Australia has been proposed for the attempt but there are many difficulties to overcome in making the site ready.

DONALD CAMPBELL's new attempt to break the world's land speed record will probably be made in May or June of next year. His car, "Bluebird," is now almost complete at the Coventry works of Motor Panels Limited and preliminary surveys of Lake Eyre in Australia to determine its suitability for the attempt have yielded promising results. With speeds well in excess of 400 mph, the limitations of the Bonneville salt flats in Utah, where the recent attempts have been made, have become dangerously apparent.

Whatever was lost last September, when Bluebird ran off course and overturned at 300 mph, the basic strength of the design was proven and almost all the components housed within the perimeter of the body have been used again in the reconstructed car. The entire body, wheels, suspension units and axles are new, but of the internal units returned to their individual makers for examination and report only a propeller shaft and certain items in one of the gearboxes were found to be in need of replacement. The Proteus engine, weighing 1 ton, was still running immediately after the crash and, apart from causing the bulkheads to bow slightly, it remained firmly attached to its mountings.

TAIL FIN

Although the general configuration remains virtually unchanged, certain modifications have been made, some no doubt being the direct result of lessons learnt at Bonneville. Of these, the most obvious and important is the addition of a tail-fin which, it is hoped, will improve stability at high speed. Of ingenious design, the fin has been constructed in sections so that during preliminary trials it can be progressively reduced in size until an optimum compromise between stability and drag is attained.



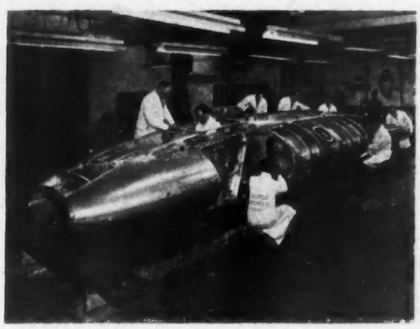
Profile of the car showing the proposed tailfin which has been designed to make the car aerodynamically stable.

The complete fin stands 7 ft 8½ in off the ground and the increase in air drag brought about will be approximately 3 per cent. It gives rise to two disadvantages in that more thrust is required to attain a given speed and the increased side area will make the car more susceptible to cross winds. With 4,000 bhp available the first of these may be conditionally discounted, but when travelling at high speed a high rate of yaw can start a gyroscopic precession of the 52 in wheels, resulting in the formation of a roll couple. The presence of the fin restricts the rate of yaw and hence the chances of overturning.

Another important modification has entailed the rearrangement of certain components to facilitate adjustment of the centre of gravity. The CG on the original car fell just aft of the centre line and ballast was required to bring it forward to the ideal position just in front. Now, in theory, the position is correct without ballast and small alterations will be possible on site, if trials reveal the need. Also, to improve stability during acceleration, the differentials in the gearboxes have been locked.

SAFETY PRECAUTIONS

Provision has been made for governing the power available to the throttle. With only 1½ in of travel between stop and full power, it was difficult to build up slowly. It is hoped eventually to incorporate a linkage whereby a given output may be selected and maintained.



The completely new body takes shape. The eternal services connection panel can be seen in its new location on the left of the engine aperture and an air brake is being extended on the extreme right.

More lessons learnt at Bonneville concern ease of service and improved safety precautions. The service connection panel for the external starting and jacking gear has been moved to the side of the car from the back where it was mounted previously in close proximity to the hot exhaust outlets; and the track rods have been modified to facilitate ready adjustment of the steering geometry.

The old perspex cockpit canopy has been scrapped and replaced by one of epoxy resin bonded with fibreglass, reputedly capable of withstanding a load of 20 tons. Much importance has been attached to this as Mr. Campbell's most serious injury in the crash was a hair-line fracture of the skull caused when his head hit the side of the canopy, shattering his crash helmet. The new canopy will be lined with some impact absorbing material to alleviate the possibility of a recurrence.

REMOTE COURSE

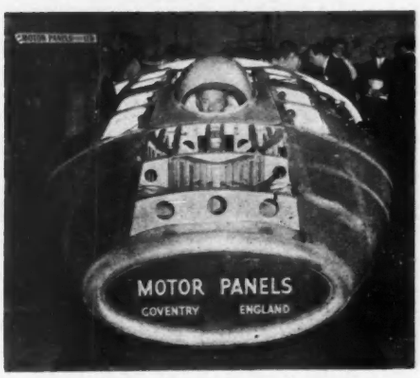
Lake Eyre offers many advantages to the prospective record breaker and, in contrast to Bonneville, which tends to get rather wet and is only suitable for record breaking during two months of the year, its surface, containing ingrained sand particles, is rock hard. The presence of sand makes it more abrasive than Bonneville and tyre wear will be accelerated, one of many obstacles still to be overcome. Not the least of these is the problem of the lake's extreme inaccessibility in a remote desert region roughly halfway between Adelaide and Alice Springs, which are about 1,000 miles apart. The closest habitation is a good 30 miles away and the area is devoid of fresh water. Preparation work will include well sinking and the construction of a road to the site from the primitive Adelaide—Alice Springs railway, which is a complication in itself as it includes three changes of gauge.

Parts of the salt surface will require extensive preparation as it is broken by salt islands—rough outcrops, the origin of which is obscure, though they were most probably blown up by wind action just before the surface solidified. Aerial survey of these formations seems to substantiate this theory. The maximum height of these is about 10 in, most of which can be broken off. But finish treatment will have to be a scarifying action with an instrument best described as a milling cutter. At present a stretch of about seven miles is serviceable but Campbell is hoping for twenty miles—almost twice the length of Bonneville—thus giving him more time to gather speed at a slower rate of acceleration. Previously the car was forced to accelerate from 0 to 300 mph in two miles which closely approaches the limit of adhesion.

Credit for the discovery of Lake Eyre must to to BP (Australia) whose investigation team discovered that the last rain fell in 1955 when the whole area was flooded to a depth of 16 ft. Provided nature is kind and sends no more downfalls before next summer, Donald Campbell, his team and their excellent creation should have a good chance of breaking a record that has stood since 1947.

AMERICAN RIVAL

However, the physical and technical problems are not the only obstacles to be overcome.



Donald Campbell gives the " thumbs up " from within the claustrophobic confines of Bluebird's cockpit.

1960 saw no fewer than six cars at Bonneville, although one, a pure jet, was not eligible for the official record. Of these attempts, the most successful driver was the American Mickey Thompson, whose car, Challenger I, has four Pontiac V8 engines, each of which is said to produce over 800 bhp. Thompson has already exceeded the record speed in one direction with 406·60 mph, but a half-shaft failure on the return run thwarted his effort. It would be interesting to see a match between these two, reminiscent of the years just before the war when Eyston and Cobb alternated in raising the speed record. Bluebird's ultimate potential, with 4,000 bhp, must be greater than that of the American car but though this may be the essence, it is not the entirety, of record breaking.

Last week we referred to Mr. Fabian Samengo-Turner as deputy general manager of Yeoman Credit Limited. He is in fact deputy managing director.

Plain Words

By Capricorn

GEORGE BERNARD SHAW was prone to assume that a characteristic habit of industrialists was the suppressing of inventions which conflicted with their vested interests. I feel sure that there was never much truth in that scandalous accusation, though of course it was splendid raw material for a dramatist. Shaw probably met an eccentric inventor who had a chip on his shoulder, but that playful playwright should be living today, to see our reverence of research and the daily evidence of new ideas. A prize of £5,000 is offered for a man-powered aircraft, and groups of keen young graduates burn the midnight oil to build a machine and win the prize.

Today, according to Lord Chandos, a new obstacle to progress has appeared. "In general," he remarked recently, "the truth is that man's ingenuity has outrun his ability to finance his inventions." There are few heads of electrical companies, he lamented, who are not familiar with the scene when one of their scientists or engineers comes in and says, "We can do this in a different way," or "We have found something which is quite new." The head of the business says, with some nervousness, "How much capital is needed?" The engineer replies, "Well, not very much, Chairman, about £2½ million for the plant, about £1½ million in working capital, and one year's partial operation while the plant is being run in. Anyway, it will be well under £5 million." Lord Chandos concludes his story with: "This is a shock which one can stand from time to time, but when it becomes too frequent, and if you have had a bad dinner, or lost a large order, you are apt to wish that your scientists and engineers would not be quite so inventive."

How would Lord Chandos exercise the wisdom of Solomon in such cases? Bring in other engineers whose views may be expected to conflict, and hear them argue the proposal in parliamentary style, if not in parliamentary language? Or does he assess the applicants' ability and staying power—the factors which will ultimately produce a profit or a loss on the capital invested? I am sure he makes them express their proposals in writing, in plain words with the argument worked out logically, if only because that can be as searching a test of a man's technical argument as any cross-examination from the head of a business.

A chairman can take comfort from the fact that engineers and scientists are very conscious of their professional reputation. They will go to great lengths to enhance it, but they will take great care to safeguard it, especially if they are middle-aged or elderly. If they are young, they have probably not had the sobering experience of an invention that misfired, so they may be slightly reckless. Alas, for the poor chairman—it is the young who usually have the brightest ideas!

Letters to the Editor

Regulations for Ionising Radiations

SIR, We wish to draw the attention of industrial users of ionising radiations to regulation 13(3) of the Ionising Radiations (Sealed Sources) Regulations, 1961, which recently came into operation.

This states that dosimeters or dose rate meters must be retested by a qualified person at least once in every period of fourteen months, as well as after any repair which may have affected the accuracy of the meter.

It would appear that either the meter must be returned to the manufacturer for calibration or the user must calibrate the meter using a standard radiation source. The latter method requires a reasonable knowledge of radiation measuring techniques and improperly carried out would lead to an increase in the possible radiation hazard.

If the meter is returned to the manufacturer then a duplicate monitor may be needed to cover the period while the meter is being recalibrated.

We feel that this implication of the regulations may not be immediately apparent to those whom it affects.

Yours faithfully,
D. D. CARRUTHERS,
D. T. TURNBULL.

Department of Physics,
Rutherford College of Technology,
Newcastle upon Tyne.
29 November, 1961.

Speaking for the Professional Engineer

SIR, I read with interest the letter on "Speaking for the Professional Engineer," from Mr. James A. Harley (ENGNG., 1 Dec. '61, p. 702).

For the sake of accuracy and for the information of Mr. Harley (who ought to know this, as he states he is a member of the American Society of Mechanical Engineers), I would like to point out that the American Society of Mechanical Engineers' journal is not entitled *Machine Design*; it is in fact *Mechanical Engineering*.

Machine Design is published by the Penton Publishing Company of Cleveland.

Yours very truly,
R. T. EVERETT,
Librarian.

The Institution of Mechanical Engineers,
London SW1.
1 December, 1961.

Events in Advance

Europe's Views on Chemical Engineering

AMONG the important conferences scheduled to take place in London next year, mention may be made of the Third Congress of the European Federation of Chemical Engineering which is due to be held at Olympia, London W14, in June, 1962.

The congress will actually comprise a number of different meetings. On 20 June, there will be a meeting on "Process Optimization" and, from 21 June to 23 June, a meeting on "Interaction Between Fluids and Particles." These will be followed, on 25 June, by a symposium on "The Handling of Solids" and, from 26 June to 28 June, there will be a symposium on "The Physics and Chemistry of High Pressures," which is being organized by the Society of Chemical Industry.

This international symposium on the physics and chemistry of high pressures will cover theoretical, experimental and applied work on pressures from around 1,000 atm upwards. The subjects to be discussed will include changes of phase, the study of optical, electrical and other physical properties, the equilibria and rates of chemical reactions, as well as work on new techniques, equipment and design. Work on transient properties, such as explosive and shock waves, however, will not be discussed.

In the United Kingdom, all communications relating to these meetings should be addressed to the general secretary, the Society of Chemical Industry, 14 Belgrave Square, London SW1. Tel. BELgravia 3681. The general secretariat of the congress will be at 16 Belgrave Square, London SW1.

Works Managers Form Midland Regional Board

INAUGURATION of the newly-formed Midland Regional Board of the Institution of Works Managers took place on 29 November at Coventry.

Mr. R. S. Robinson, B.Sc., M.I.Mech.E., deputy personnel director, Tube Investments Limited, Edgbaston, Birmingham, was appointed chairman, with Mr. A. V. Albutt, general manager, Ephraim Phillips Limited, Birmingham, as deputy chairman.

The regional board comprises the following branches of the Institution: Birmingham, Coventry, Leicester, Northampton, Notts and Derby, South Wales, West of England and Wolverhampton. Headquarters of the Institution of Works Managers are at 196 Shaftesbury Avenue, London WC2.

Events in 1962

WITH the current issue of ENGINEERING, there is being distributed a loose inset folder entitled "Events in 1962."

The folder also includes particulars of a number of events due to take place in 1963, of which some details have now been issued. The great majority of the events included in the folder have not so far been mentioned in the Events in Advance columns.

Additional copies of the folder may be obtained free of charge on application to the Publisher, ENGINEERING, 36 Bedford Street, London WC2.

Rolling Mill Practice

A SYMPOSIUM on "Modern Rolling-Mill Practice" is being sponsored by the Institution of Plant Engineers and will take place at the University Engineering Lecture Theatre, St. George's Square, Sheffield, on 11 April, 1962. The choice of Sheffield as the venue for this symposium, which is the first to be arranged by the Institution in the provinces, has been made having regard to the city's importance as one of the main centres of rolling-mill manufacture and operation in Britain.

Recent engineering developments in the design, control and servicing of rolling-mill plant have made such strides that the Institution feels that there is a need at the present time for the general exchange of current knowledge.

Three papers will be presented: "Developments in the Design of Rolling Mills," by Dr. R. B. Sims and P. A. Clark; "Modern Control Techniques for Rolling Mills," by P. E. Peck; and "Modern Techniques for Servicing Rolling Mills," by R. N. Dale. Mr. Peck's paper will include a description of a new mill for the rolling of thin tinplate materials.

It is intended that preprints of these papers shall be available prior to the meeting. The symposium fee will be two guineas per person, to include one set of preprints and certain refreshments. Additional preprints may be obtained at a charge of one guinea a set. Application forms and further particulars are obtainable from the secretary, the Institution of Plant Engineers, 2 Grosvenor Gardens, London SW1, or by telephoning SLOane 0469.

Meetings and Papers

The address and telephone number of the headquarters of each institution are given at the end of this list. Meetings in the headquarters town are held there unless otherwise stated.

Association of Supervising Electrical Engineers

LONDON
"Stage Lighting 1961": Discussion. Central London Branch. Demonstration Theatre, Strand Electric and Engineering Co., Ltd., 29 King Street, WC2. Mon., 11 Dec., 7.15 p.m.

British Institution of Radio Engineers

LONDON
Display of Technical Films. London School of Hygiene and Tropical Medicine, Keppel Street, WC1. Wed., 20 Dec., 6 p.m.
BRISTOL
"Transistors in Transmitters and Communications Receivers," by D. C. Carey. Annual General Meeting. South Western Section. School of Management Studies, Unity Street, Bristol. Wed., 20 Dec., 6 p.m.

British Interplanetary Society

DERBY
"Some Astronomical and Astronautical Aspects of the Moon," by K. Fea. Midlands Branch. Seven Stars Inn, 97 King Street, Derby. Mon., 18 Dec., 7.30 p.m.

Diesel Engineers and Users Association

LONDON
"Annual Report on Oil and Gas Engine Working Costs and Performance," presented by J. R. P. Smith. Institute of Marine Engineers, 76 Mark Lane, EC3. Thurs., 14 Dec., 2.30 p.m.

Institute of Marine Engineers

NEWCASTLE UPON TYNE
"Trials and Operation of the Gas Turbine Ship Auris," by R. M. Duggan and A. T. O. Howell. North East Coast Section. Stephenson Building, King's College, Claremont Road, Newcastle upon Tyne. Thurs., 14 Dec., 6.15 p.m.

Institute of Metals

BIRMINGHAM
"Science in the Service of Metallurgical Industry," by H. Morrogh. Birmingham Local Section. Christmas Lecture for School Children. Birmingham and Midland Institute, Paradise Street, Birmingham. Tues., 19 Dec., 2.30 p.m.
SWANSEA
"Some Theoretical Aspects of the Sintering of Metal Powders," by Dr. G. A. Geach. South Wales Local Section. Metallurgy Department, University College, Swansea. Tues., 12 Dec., 6.30 p.m.

Institute of Petroleum

LONDON
"Economics of Tanker Design," by I. B. Blackwood. Wed., 3 Jan., 5.30 p.m.

Institute of Road Transport Engineers

LONDON
Open Discussion Meeting. Metropolitan Area. Royal Society of Arts, John Adam Street, Adelphi, WC2. Thurs., 21 Dec., 6.30 p.m.
BIRMINGHAM
"Oil Additives," by Dr. E. P. Wright. Midlands Centre. Engineering and Building Centre, Stephenson Place, Birmingham 1. Tues., 12 Dec., 7.30 p.m.
LIVERPOOL
"Oil Additives," by Dr. E. P. Wright. North Western Centre. Merton Hotel, Merton Road, Bootle, Liverpool 20. Wed., 13 Dec., 7.30 p.m.

Institution of Agricultural Engineers

NEWCASTLE UPON TYNE
"Irrigation, with Special Reference to Organic Irrigation," illustrated, by W. T. A. Rundle. Northern Branch. Offices of the North Eastern Electricity Board, Carliol House, Market Street, Newcastle upon Tyne 1. Mon., 11 Dec., 6.45 p.m.

Institution of Civil Engineers

LONDON
"Traffic Design of Parking Garages": Informal Discussion. to be introduced by L. T. C. Beasley. Traffic Engineering Group. Thurs., 14 Dec., 5.30 p.m.
"The Hirfanli Hydro-Electric Scheme," by G. B. Finch and N. K. Webb. Tues., 19 Dec., 5.30 p.m.

Institution of Electrical Engineers

LONDON
"Large Microwave Steerable Aerials for Communication with Artificial Earth Satellites and Space Probes," by F. J. D. Taylor. Electronics and Communications Section. Mon., 18 Dec., 5.30 p.m.
"The Use of Controllable Semiconductor Rectifiers in Machine Control," by K. G. King. Measurement and Control Section. Tues., 19 Dec., 5.30 p.m.
"Satellite Instrumentation," by Dr. R. L. F. Boyd. Electronics and Communications Section. Wed., 20 Dec., 5.30 p.m.
ABERDEEN
"Protection of Electrical Systems," by H. G. Bell. North Scotland Subcentre. Robert Gordon's Technical College, Aberdeen. Fri., 15 Dec., 7.30 p.m.
DUNDEE
"Protection of Electrical Systems," by H. G. Bell. North Scotland Subcentre. Electrical Engineering Department, Queen's College, Dundee. Thurs., 14 Dec., 7 p.m.
EDINBURGH
"Analysis of Overall Stability of Multi-Machine Power Systems," by J. G. Miles. South East Scotland Subcentre. Carlton Hotel, North Bridge, Edinburgh. Tues., 12 Dec., 7 p.m.
GLASGOW
"Analysis of Overall Stability of Multi-Machine Power Systems," by J. G. Miles. South West Scotland Subcentre. Institution of Engineers and Shipbuilders in Scotland, 39 Elmbank Crescent, Glasgow C2. Wed., 13 Dec., 6 p.m.
CARDIFF
"Application of Electronics to the Electricity Supply Industry," by Dr. J. S. Forrest. Third Hunter Memorial Lecture. Western Centre. South Wales Institute of Engineers, Park Place, Cardiff. Mon., 11 Dec., 6 p.m.
LEICESTER
"Some Notes on the Electrical Requirements of General Cargo Docks," by E. R. Radway. East Midland Centre. Joint Meeting with the Leicester Association of Engineers. Technical College, Leicester. Fri., 15 Dec., 7 p.m.
LIVERPOOL
"Education of an Electrical Engineer," by Professor M. R. Gavin; and "The Place of Formal Study in the Post-Graduate Training of an Electrical Engineer," by N. N. Hancock and P. L. Taylor. Mersey and North Wales Centre. Royal Institution, Liverpool. Mon., 18 Dec., 6.30 p.m.
NEWPORT
"Cable Fault Localization," by J. H. Classey. Southern Centre. Offices of the Southern Electricity Board, Newport, Isle of Wight. Fri., 15 Dec., 6.30 p.m.

Institution of Engineers and Shipbuilders in Scotland

GLASGOW
"Diesel-Electric Propulsion Equipment in Western Germany," by Dipl.-Ing. H. Jung and F. Fass. Tues., 12 Dec., 6.30 p.m.

Institution of Heating and Ventilating Engineers

LONDON
"Fire Protection in Buildings," by E. A. Hibbitt. Institution of Mechanical Engineers, 1 Birdcage Walk, St. James's Park, SW1. Thurs., 14 Dec., 6 p.m.
GLASGOW
"Vibration Isolation," by E. H. Sims. Scottish Branch. Scottish Building Centre, 425 Sauchiehall Street, Glasgow C2. Tues., 19 Dec., 7 p.m.

Institution of Highway Engineers

LEEDS
"The Doncaster Motorway: Reflections in Retrospect," by Colonel S. M. Lovell. Yorkshire and Lincolnshire Branch. Metropole Hotel, Leeds. Wed., 13 Dec., 6.30 p.m.

Institution of Locomotive Engineers

LONDON
"Engineering Aspect of Catering on Trains": Symposium, comprising "British Railways Experience," by H. Wilcock; "Overseas Experience," by W. E. Bulman; "From the Catering Manater's Viewpoint," by H. Simons. Institution of Mechanical Engineers, 1 Birdcage Walk, St. James's Park, SW1. Thurs., 21 Dec., 5.30 p.m.

Institution of Mechanical Engineers

LONDON
"The Teaching of Machine Tool Technology as an Academic Subject: Discussion. Education and Training Group. Mon., 18 Dec., 6 p.m.
"Effect of Ambient Conditions on the Performance of Turbo-Charged Diesel Engines": Discussion. Internal Combustion Engines Group. Wed., 20 Dec., 6 p.m.
BIRMINGHAM
"The Challenge of Vertical Take-off." Part I, "Helicopters," by G. S. Hislop. Part II, "Jet Lift," by D. Keith-Lucas. Repetition of the Leonardo da Vinci Lecture. Midland Branch. Birmingham and Midland Institute, Paradise Street, Birmingham. Thurs., 14 Dec., 2.30 and 6.30 p.m. (Intended for school leavers: tickets required.)
BRIGHTON
"Commonwealth Telecommunications," by J. A. Smale. Southern Branch. King and Queen Hotel, Brighton. Thurs., 14 Dec., 7.30 p.m.
BRISTOL
"Maintenance Experience on Calder Reactors," by J. R. Treharne, Nuclear Energy Group: Western Branch Area. Engineering Laboratories, The University, Bristol. Thurs., 14 Dec., 7 p.m.
EXETER
"Recent Development in Gas Welding": Discussion. Western Branch. Rougemont Hotel, Queen Hotel, Exeter. Fri., 15 Dec., 7 p.m.

Institution of Mining and Metallurgy

LONDON
"Dependence of the Floatability of Antimonite on the Value of Zeta-Potential," by Professor B. V. Derjaguin and Mrs. N. D. Shukakidse; and "Radon Determination as a Prospecting Technique," by Dr. J. D. Peacock and R. Williamson. Geological Society, Burlington House, Piccadilly, W1. Thurs., 21 Dec., 5 p.m.

Institution of Production Engineers

DONCASTER
"Continuous Casting," by G. Littlewood. Doncaster Section. Technical College, Waterdale, Doncaster. Tues., 12 Dec., 7 p.m.
FARNBOROUGH
"Practical Applications of Production Engineering Research," by Dr. D. F. Galloway. Reading Section. Farnborough Technical College, Boundary Road, Farnborough. Thurs., 14 Dec., 7.30 p.m.
LIVERPOOL
"The Production Engineer's Approach to Domestic Appliance Manufacture," by V. J. Adams. Liverpool Section. Central Library, William Brown Street, Liverpool. Wed., 13 Dec., 7.30 p.m.

Institution of Public Health Engineers

LONDON
"Fresh Water from Sea Water," by William K. J. Weir. Caxton Hall, off Victoria Street, SW1. Thurs., 14 Dec., 6 p.m.

Institution of Structural Engineers

GLASGOW
"Cable Spinning on the Forth Road Bridge," by H. Shirley Smith. Scottish Branch. Institution of Engineers and Shipbuilders in Scotland, 39 Elmbank Crescent, Glasgow C2. Fri., 15 Dec., 7 p.m.
LIVERPOOL
"Construction of a Large Covered Reservoir," by J. W. Baron. Lancashire and Cheshire Branch. Wed., 13 Dec., 6.30 p.m.
SWANSEA
"Design of Reinforced Concrete Through the Use of Plastic Models," by B. W. Preece. Wales and Monmouthshire Branch. The University, Swansea. Fri., 15 Dec., 6.30 p.m.

Junior Institution of Engineers

LONDON
"The Turn of the Century: A Pictorial Survey," illustrated by slides, by J. Foster Petree. Fri., 29 Dec., 7 p.m.

North East Coast Institution of Engineers and Shipbuilders

NEWCASTLE UPON TYNE
"Investigations into the Strength of Underdeck Girders Carried Out at Glengarnock," by K. V. Taylor and J. S. Shand. Neville Hall, Westgate Road, Newcastle upon Tyne. Fri., 15 Dec., 6.15 p.m.

Radar and Electronics Association

LONDON
"Loudspeaker Enclosures," by J. Gough and Professor F. Landgrebe. Royal Society of Arts, John Adam Street, Adelphi, WC2. Thurs., 14 Dec., 7 p.m.

Reinforced Concrete Association

BIRMINGHAM
"Recent Developments in Prestressed Concrete," by B. Rhodes. Midland Counties Branch. Birmingham and Midland Institute, Paradise Street, Birmingham. Tues., 12 Dec., 6 p.m.

Royal Meteorological Society

LONDON
"A Graphical Method of Objective Forecasting Derived by Statistical Techniques," by M. H. Freeman; and other papers. Wed., 20 Dec., 5 p.m.

Royal Society of Arts

LONDON
"Tin: Its Contribution to Social Development," by Dr. E. S. Hedges. Wed., 13 Dec., 6 p.m.

Royal Statistical Society

LONDON
"A Statistical Computing Service," by M. J. R. Healy. General Applications Section. Royal Institute of Public Health and Hygiene, 28 Portland Place, W1. Tues., 19 Dec., 6.15 p.m.

Royal United Service Institution

LONDON
"Some Reflections on the Strategic Air Offensive, 1935-45," by Dr. Noble Frankland. Wed., 13 Dec., 3 p.m.

Sheffield Metallurgical Association

SHEFFIELD
"Vacuum Melting of Steels," by R. Hall. BISRA Laboratories, Hoyle Street, Sheffield. Tues., 19 Dec., 7 p.m.

Society of Chemical Industry

LONDON
"Experimental Survey of Rust Preventives in Water"; Parts I, II and III, to be introduced briefly by A. Robertson; and "Corrosion of Metals by Acid Vapours from Wood," by A. Clarke and A. Longhurst. Corrosion Group. Wed., 20 Dec., 6 p.m.

Society of Instrument Technology

BRISTOL
"Atomic Clock," by Dr. L. Essen. Bristol Section. Department of Physics, The University, The Royal Fort, Bristol 8. Thurs., 14 Dec., 7.30 p.m.
CHESTER
"Design, Application and Selection of Automatic Control Valves," by P. Stone. Chester Section. Stanley Palace, Watergate Street, Chester. Tues., 12 Dec., 7 p.m.
GRANGEMOUTH
"Instrumentation of Space Vehicles," by Dr. A. E. Roy. Grangemouth Section. Leapark Hotel, Bo'ness Road, Grangemouth. Thurs., 21 Dec., 7 p.m.
LIVERPOOL
"Versatility of the Electronic Potentiometer," by F. W. J. Howard. Liverpool Section. Industrial Centre, Merseyside and North Wales Electricity Board, Paradise Street, Liverpool. Thurs., 14 Dec., 7 p.m.
MANCHESTER
"Instrumentation for Oil-Fired Glass Furnaces," by N.I. Walker. Manchester Section. Literary and Philosophical Society, 36 George Street, Manchester 1. Wed., 13 Dec., 6.45 p.m.
NEWCASTLE UPON TYNE
Open Discussion Meeting. Newcastle Section. Roadway House, Oxford Street, Newcastle upon Tyne. Wed., 13 Dec., 7 p.m.

South Wales Institute of Engineers

CARDIFF
"Modern Process Control," by O. G. Pamely-Evans. Thurs., 14 Dec., 6 p.m.

Southampton Metallurgical Society

SOUTHAMPTON
"Fatigue," by T. R. G. Williams. The University, Southampton. Thurs., 14 Dec., 7.15 p.m.

Events in Advance

Association of Supervising Electrical Engineers, 23 Bloomsbury Square, London WC1. (LANgham 5927)
British Institution of Radio Engineers, 9 Bedford Square, London WC1. (MUSeum 1901)
British Interplanetary Society, 12 Besborough Gardens, London SW1. (TATe Gallery 9371)
Diesel Engineers and Users Association, 18 London Street, London EC3. (ROYal 2393)
Institute of Marine Engineers, Memorial Building, 76 Mark Lane, London EC3. (ROYal 8493)
Institute of Metals, 17 Belgrave Square, London SW1. (BELgravia 3291)
Institute of Petroleum, 61 New Cavendish Street, London W1. (LANgham 3583)
Institute of Road Transport Engineers, 1 Cromwell Place, South Kensington, London SW7. (KENsington 3744)
Institution of Agricultural Engineers, 6 Queen Square, London WC1. (TERminus 0140)
Institution of Civil Engineers, Great George Street, London SW1. (WHItehall 4577)
Institution of Electrical Engineers, Savoy Place, Victoria Embankment, London WC2. (COVent Garden 1871)
Institution of Engineers and Shipbuilders in Scotland, 39 Elmbank Crescent, Glasgow C2. (Central 5181)
Institution of Heating and Ventilating Engineers, 49 Cadogan Square, London SW1. (SLOane 3158)
Institution of Highway Engineers, 47 Victoria Street, London SW1. (ABBey 3891)
Institution of Locomotive Engineers, 28 Victoria Street, London SW1. (ABBey 6672)
Institution of Mechanical Engineers, 1 Birdcage Walk, St. James's Park, London SW1. (WHItehall 7476)
Institution of Mining and Metallurgy, 44 Portland Place, London W1. (LANgham 3802)
Institution of Production Engineers, 10 Chesterfield Street, London W1. (GROsvenor 5254)
Institution of Public Health Engineers, 169–181 Vauxhall Bridge Road, London SW1. (VICtoria 3017)
Institution of Structural Engineers, 11 Upper Belgrave Street, London S.W.1. (SLOane 7128)
Junior Institution of Engineers, Pepys House, 14 Rochester Row, London SW1. (VICtoria 0786)
North East Coast Institution of Engineers and Shipbuilders, Bolbec Hall, Newcastle upon Tyne 1. (Newcastle 20289)
Radar and Electronics Association, 4–5 Mount Street, London W1. (GROsvenor 4477)
Reinforced Concrete Association, 94–98 Petty France, London SW1. (ABBey 4504)
Royal Meteorological Society 49 Cromwell Road, South Kensington, London SW7. (KENsington 0730)
Royal Society of Arts, John Adam Street, Adelphi, London WC2. (TRAfalgar 2366)
Royal Statistical Society, 21 Bentinck Street, London W1. (WELbeck 7638)
Royal United Service Institution, Whitehall, London SW1. (WHItehall 5854)
Sheffield Metallurgical Association, 64 Crescent Road, Sheffield 7. (Sheffield 52865)
Society of Chemical Industry, 14 Belgrave Square, London SW1. (BELgravia 3681)
Society of Instrument Technology, 20 Queen Anne Street, London W1. (LANgham 4251)
South Wales Institute of Engineers, Park Place, Cardiff. (Cardiff 23296)
Southampton Metallurgical Society. Apply to Mr. S. W. Hallwood, Folland Aircraft Limited, King's Avenue, Hamble, Hampshire.

Human Element

Safety Example from Managers

THIS quarter's issue of the Ministry of Labour's publication, *Accidents—How They Happen*, contains the usual disturbing list of causes of accidents. Over a quarter of industrial injuries, for example, continue to happen during manual handling of materials and products.

In talking of management's responsibility for establishing a high standard of safety, the booklet describes how managers should not only set up safe conditions but should help to maintain them by their own example. In the words of the publication, "It is for management to lay down the policy and to take all practicable steps to see that it is carried out. Among such steps few are more potent than the force of example. The manager who enters a foundry without eye protection at pouring time can easily undermine the effectiveness of a well-intentioned safety policy. Unless the interest of management at all levels is clearly shown and put into practice, all other efforts will be in vain."

This is an important point. It is a strange fact that managers sometimes seem to behave within their factories (perhaps because they are too busy to think twice) as if they were immune from the physical dangers against which they warn their operatives. Unfortunately, the operatives have no illusions about management's supernatural powers and, understandably, feel that Jack can get away with it as well as his Master.

Machine Tool Design Scholarships

Early in 1959 the Machine Tool Trades Association announced its plans for setting up a two-year post-graduate standard course in machine tool design at Manchester College of Science and Technology. Last week, it celebrated the fact that the first nine students (drawn from six firms) had completed the course.

An important feature of the course is that students have an opportunity during their vacations of working on industrial projects which differ from their previous experience. Indeed, the nine who have now passed through the pipeline had the invaluable experience of working on projects in machine tool firms on the Continent.

Two basic types of student have been selected for these courses. One is the man aged about 30 who has already worked in machine tool design offices, has served an engineering apprenticeship and is of graduate standard in one of the engineering institutions. The second type is the man who holds a first degree in engineering (or, in future, a Diploma in Technology) but has relatively little industrial experience. The former finds his academic ability and education broadened by the course, and the latter receives a guided and concentrated introduction to practical design problems. Most significant of all, perhaps, the two types tend to cross-fertilize each other's ideas and attitudes.

The machine tool industry has often been criticized as an unprogressive body and, certainly, ergonomics and the development of machine tool control have shown the need for radical rethinking of machine tools. It is very much to be hoped that the joint efforts of the Machine Tool Trades Association and of the Manchester College of Science and Technology are now providing the impetus for this rethinking.

Too Long Apprenticeships?

The proximity of the Common Market has provoked much thought (perhaps it would be too much to expect action, as well) on the efficacy of some of industry's most venerable sacred cows. One of these sacred cows is the five-year period for apprenticeships. There has been an increasing feeling among people who see apprenticeships as genuine training, instead of sources of cheap production labour, that five years is unnecessarily long with present day training methods. Now, with French and German examples before us, this feeling is stronger than ever.

At a recent weekend conference, held jointly by the Industrial Welfare Society and the British Association for Commercial and Industrial Education, Mr. Peter Perry, the director of BACIE, pointed out again that the standard apprenticeship period is wastefully in excess of the time required to train a man. There was strong agreement for this view from both other speakers and the floor of the conference.

Unfortunately, however, it requires more than a few shouts of "hear! hear!" from a conference at Brighton to bring united action—or, even, united constructive thinking—on such a time honoured institution. There is depressingly little real evidence that either the employers' organizations or the trade unions are seriously concerned about taking this particular sacred cow by the horns.

Meanwhile, BACIE's voice continues to cry powerfully in the wilderness. For the whole of this week, it has been holding a residential course on *The Background to Apprentice Training*, a course which has been attended by apprentice supervisors and training officers from industry, government departments, the nationalized industries and the armed forces. It has also announced that further such residential courses will be held during 1962 from 26 to 30 March, from 9 to 13 July, and from 3 to 7 December.

500th FBI Overseas Scholarship

Last week, at a ceremony at the Federation of British Industries' headquarters, Sir Keith Joseph, Minister of State at the Board of Trade, presented a certificate to Senor Rafeal Eduardo Castillo Valdez (the ceremony is illustrated below) the 500th scholar to visit Britain under the FBI Scholarship Scheme. Senor Valdez was formerly a student at the University of San Carlos, Guatemala, and graduated from the Brigham-Young University, Utah, USA, before working for the Empresa Electrica de Guatemala. He is now to work with the Glasgow civil engineers, James Williams and Partners.

The FBI Scholarship Scheme came into being because it was felt that the large-scale industrial and economic

developments now being undertaken in the less developed countries of the world required this country's assistance, not only in hardware, but also in the provision of a broad practical knowledge of engineering.

A number of British firms have cooperated most generously in providing practical experience. Now, there is a thriving FBI Scholars Association through which past and present scholars keep in touch with each other and with the FBI. Each of them receives the Association's journal, *The FBI Engineer*.

Apprentices a Precious Investment

Apprentices are a valuable investment (one large manufacturing firm estimated recently that it costs them £5,000 to train a craft apprentice) and most firms in industry probably treat them as such. This means not only training them in particular skills, but giving them a wider awareness of the relationships within their company and of the economic necessity for the company's products. In other words, it means giving apprentices that sense of purposeful belonging so beloved of personnel managers and psychologists (if the latter category does not include the former, anyway) alike.

This is not an easy object to live up to in manufacturing industry, but it is even more difficult to attain in large civil engineering firms with their staff and apprentices dispersed among a variety of contracting sites. This is part of the significance of the recent occasion when John Laing and Son apprentices from building and civil engineering projects in many parts of the country met at the company's London headquarters for the tenth annual apprentices' day. The day's programme included tours of the 18-acre plant and transport depot and laboratories. Later there was a film show and, in the evening, a theatre visit. The climax of the day was the presentation by the chairman, Mr. W. K. Laing, of more than £200 worth of incentive awards for success in studies and in practical work.

Works tours and prize givings, however, can be part of the stock paraphernalia of these occasions. The parts of this day's happenings which really demonstrated that here is a company aware of the value of developing its apprentices in depth were talks given by the managing director, Mr. J. M. Laing, and by Mr. H. J. O. Weaver, General Secretary of the National Federation of Building Trades Operatives.

The significance of Mr. Laing's talk was its subject matter. He spoke to the apprentices on the probable effects on the building and civil engineering industry if (perhaps one should say "when") Britain enters the Common Market. After the emotional and conflicting nonsense apprentices must have read on the subject generally in various newspapers, it must have been genuinely educational to have it related dispassionately to their own jobs and future.

Mr. Weaver's talk had a dual significance. For one thing, since trade unions are a fact of industrial life, it is important that apprentices should see that their employers and their unions can speak with one voice. For another thing, Mr. Weaver's enthusiasm for the development of new skills and for the acceptance of techniques such as work study showed them that trade unionists can be very much aware of the need for technical progress. "You apprentices," Mr. Weaver said, "have a great opportunity as a result of your basic craft training and I would recommend you to recognize the exciting times that are before us."

Management Training for Senior Engineers

The Northampton College of Advanced Technology is currently running a course, *Direction and Supervision of Scientific and Engineering Personnel*, which is designed to enable members of middle and senior management to relate their practical experience to basic management theory. The course (held on twelve full days at fortnightly intervals) includes some work in psychology and sociology, and its approach is intended to lead to the development of new insights into human behaviour and increased sensitivity in handling people. Particular subjects to be tackled are motivation, leadership and morale, stress, the effects of organization on human relations and communication, problems in management development and training, interviewing, and the conduct and chairmanship of meetings.

A course of this type is probably invaluable to any middle manager in enabling him to refresh his understanding of the basic principles of management both by relating his practical experience to theory and by exchanging experiences and ideas with managers from other firms. Nowadays, however, when so much is said about the need for more management education and when so many engineering courses fail to equip engineers for management, short priming courses of this type have a greater value than ever.

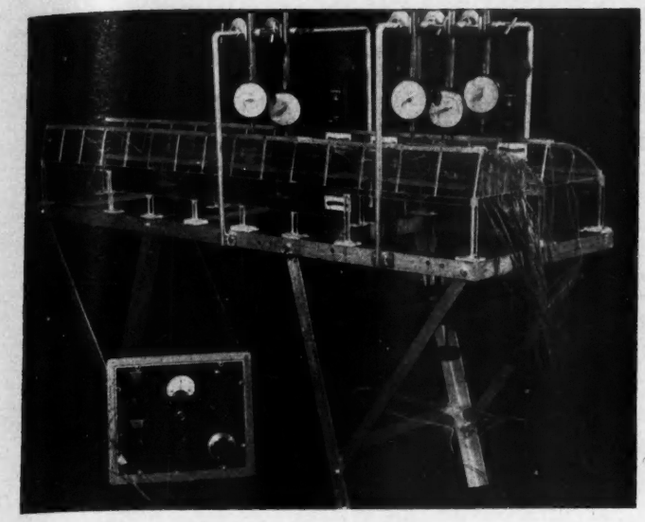


Fig. 1 (left) Structural model of the reinforced concrete roof of the CIBA factory at Lane Cove, NSW.

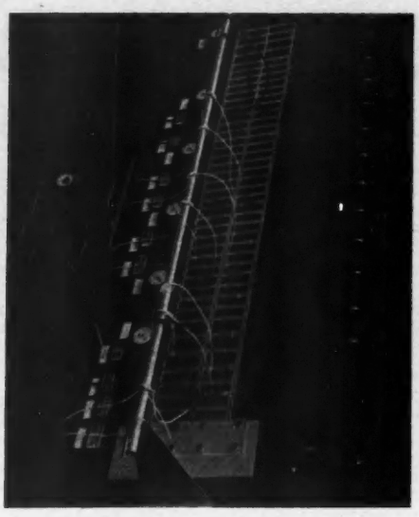


Fig. 2 (right) Structural model of one bay of the steel frame of the Chevron-Hilton Hotel, Sydney.

Architectural Use of Structural Models

Good proportions were the basis of structurally well designed classical architecture—and this still holds true. Analysis of the structure is now necessary and some advanced models have been used in Australia.

By Professor H. J. Cowan, Ph.D., M.Sc., M.I.Aust.E.

Department of Architectural Science, University of Sydney

THOUGH the use of model analysis in the design of architectural structures is essentially a post-war development, models have been used for centuries in the design of buildings. Models survive of many of the great Renaissance buildings, and it is known that in the case of some major projects several models were built.

Structural design prior to the late 18th century was mainly based on empirical rules of an essentially geometrical character, so that no clear distinction could be drawn between the proportions which make an aesthetically satisfactory building and those required for a sound structure. A fortunate by-product of this emphasis on geometry rather than on statics is the generally good proportioning of structurally well-designed classical architecture.

This empirical approach has by no means lost its validity. Few engineers fail to inform themselves about the general proportions of comparable structures before indertaking an unusual design, and the reputation of some of the contemporary structural designers best known for the gracefulness of their work rests on their ability to judge the basic structural qualities of a building from its appearance. Since the design of a building is ultimately the task of the architect, who appreciates the scientific problems more readily in a model than in a theoretical analysis, the unusual aspect should be given due consideration.

The Department of Architectural Science in the University of Sydney has now established facilities for the analysis of structural models, acoustic models and lighting models, in the first place as an aid to teaching architecture students in the regular undergraduate course. The equipment was later improved for use in research on architectural problems, and more recently structural models have been tested for architects and consulting engineers as an aid to design.

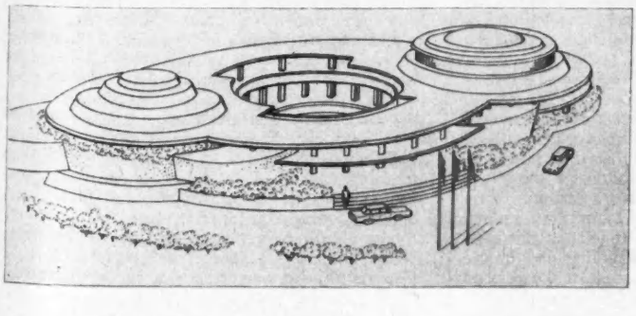
Fig. 1 shows the model of a continuous six-bay cylindrical shell roof for a factory at Lane Cove, New South Wales, the first south light shell to be constructed in Australia. The strain and deflection measurements on the model were supplemented by tests on the actual structure during the removal of the shuttering and subsequently over a period of several weeks, using strain gauges on the surface of the concrete, and on the surface of the steel embedded in the concrete.

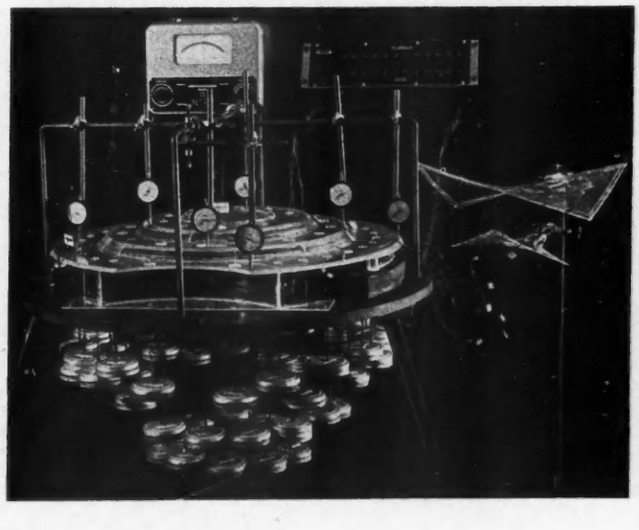
36 STOREY AUSTRALIAN HOTEL

The model in Fig. 2 represents one bay of the steel frame of the 36-storey wing of a hotel in Sydney, the highest building now under construction in Australia. Since the building is unusually tall and narrow, and not sheltered by other buildings, deflection due to wind and the stresses caused by wind loading are particularly important. The new wing is joined at right-angles to an existing 14-storey building so that the differential deflection of the two buildings is of special interest. Analysis is complicated by frequent changes in the steel cross-section, and in the storey height, by equipment ducts cut through the steelwork and by semi-rigid joints near the interior columns.

The architectural model of a club to be built in Granville, New South Wales, is shown in Fig. 3*a*, and the structural model of one of the folded plate domes in Fig. 3*b*. The structure is of an unusual type for which there is no simple solution; additional complications are introduced by the irregular spacing of the columns on one side and by the support provided by one of the intersecting circles which shortens the span across one diagonal. Arrangements are being made for installing strain gauges and deflection wires on the actual structure to check the model measurements with those obtained on removal of the formwork.

All the models illustrated were made by Mr. F. J. Dixon in the architectural science workshop of the University of Sydney.





Figs. 3a and b Model of the RSL Club, Granville, NSW. (Below) Architectural model. (Right) Structural model of one of the reinforced concrete folded plate roofs.

Extruded Bronze and Plastics in Bridge Deck Joints

The new Runnymede Bridge, which carries the Staines by-pass over the River Thames, has expansion joints of the type shown in the illustration. The principal elements of the joint are angle sections of extruded bronze and plastic composition fillers which form a hard-wearing, non-corrosive and watertight unit in the road surface.

Though this type of joint offers some immediate advantages over the conventional steel comb joint—for example, in wet weather it is unlikely to be slippery—there does seem to be a something of a limit on the size of movement it can be designed to accommodate.

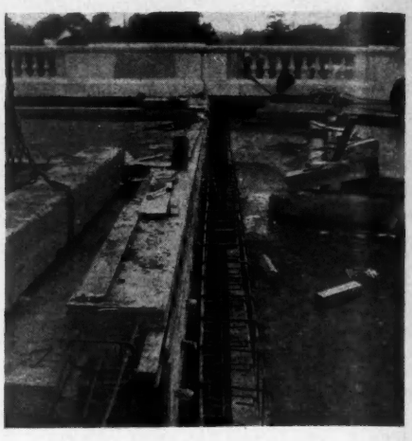
As the drawing shows, the design requires two angle bars facing each other at the mouth of the joint. The bars are lipped at the lower edge to form a shelf which supports a soft expanded plastic filler; this filler is topped by a heavy duty sealant having sufficient elasticity to permit the movements involved without cracking or breaking the bond with the angle bars. Behind each angle, the concrete is covered with an epoxy resin/sand mortar to give increased resistance to wear.

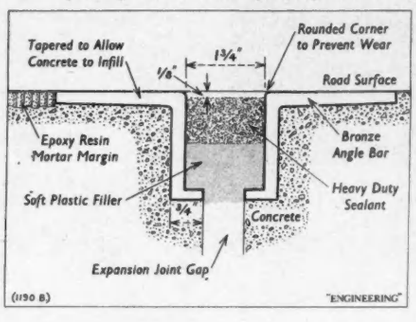
To simplify fixing the angle sections and to obtain a shape that would readily allow the poured concrete to be tamped into place, a section extruded in the Delta Metal Company's No. 4 bronze was used. The underside of the uppermost angle is tapered to assist entry of the concrete, the top corners are rounded to minimize wear and shock, and the bars have fixing lugs at roughly 3 ft centres.

Consulting engineers for the bridge were C. W. Glover and Partners of London, who designed the joint; the main contractors were W. and C. French Limited of Buckhurst Hill, Essex. The bridge was officially opened in mid-November.

(Right) Close up of the expansion joint used on the Runnymede Bridge on the Staines by-pass.

(Below) Section through the joint.





Getting Water to the Top of Tall Buildings

The increase in the height of buildings since the last war has brought many problems to the water engineer; the major problem being the provision of a continuous supply of water at a reasonable pressure to all floors. Some of the difficulties are discussed in an article by members of the Research Group (J) of the Institution of Water Engineers in the Institution's *Journal* for November, 1961 (vol. 15, No. 7).

Most water authorities recommend that adequate storage should be provided within the building to help in keeping, at a reasonable level, the peak demands on the general water distribution system. The normal and average pressure available from public water mains may be expected to be insufficient for the water to reach the upper parts of tall buildings, and therefore some form of boosting is necessary. However, it will not normally be necessary to raise all the water to the upper floors, and various floors could be separated into zones of pressure, with each zone being considered as a separate supply.

There are various opinions on the optimum height of a zone, ranging from about 10 to 13 floors; for the latter case a maximum pressure of 50 lb per sq. in (115 ft) is required.

Noise, irrespective of the pipe material and size, can be a very serious problem in multi-storey buildings, and in America it is quite common to find up to a 6 in thickness insulation around rising and down service mains as a precaution against noise transmission. To eliminate noise and vibration on pumping mains, use is made of air-reducing vessels, braided copper or copper alloy flexible connections.

The more usual forms of boosting equipment are: electrically driven centrifugal booster pumping plant fitted (i) direct to the incoming supply pipe at ground level, at an intermediate height within the building, or (ii) connected to a storage system at ground level and charged by the incoming main; electrically driven centrifugal booster pumping plant incorporating adjustable speed fluid or powder drive couplings; and hydro-pneumatic systems incorporating a centrifugal pump and pneumatic tank.

The fluid-drive plant comprises a unit, placed between the booster pump and its associated electric motor, which regulates the amount of water delivered by the pump. It is sensitive to the delivery pressures and responds to the water requirements. The powder centrifugal coupling does not operate as a variable speed device: once the unit is engaged, the driving and driven members completely lock. Both of these types of plant are capable of automatic control. Under certain conditions a " Hydrostat " equipment has been suggested, since no actual prime mover is required, but this apparatus is expensive and rather noisy.

Because of its merits, the centrifugal pump is invariably used for boosting; it may be the horizontal or vertical type with either a direct or remote drive from the motor. The power consumed is usually small, a squirrel cage motor for " direct-on " starting being employed.

Welded Wire Fabrics in Bituminous Resurfacings

In 1955 two sections of road in Massachusetts, USA, totalling three miles in length, were resurfaced with a 3 in bituminous concrete reinforced with various forms of welded wire fabric. The main purpose of the reinforcement was to prevent reflection cracks caused by the underlying slab movements.

In the past, many of the roads in the area were constructed of Portland cement concrete slabs which have subsequently been covered with a 2½ to 3 in bituminous resurfacing. The slabs are approximately 8 in thick, 10 ft wide and 57 ft long, and have been placed on a 12 in gravel base with about 0·13 per cent of longitudinal reinforcement. The roads were constructed using expansion joints comprising four 1 in load-transfer dowels for each 10 ft joint. Some observations on the operation of the joints, and a report on an investigation into reinforcement found necessary are given in *Five-year Performance of Welded Wire Fabric in Bituminous Resurfacing*—by E. Tons *et al*, in the United States Highway Research Board's Bulletin 290. The bulletin, which also contains two other associated papers, can be obtained from the Board at 2101 Constitution Avenue, N.W, Washington, DC, USA ($1·20).

The amount of horizontal joint opening has been studied in several parts of Massachusetts, and measurements show that about 80 per cent of the transverse expansion joints open 0·05 in or more during a one-year cycle. The widest joint opening measured was 0·18 in. with a maximum daily variation of about 0·04 in. Laboratory strain tests have shown that a 4 in long bituminous concrete specimen can be stretched about 0·04 to 0·05 in before it breaks.

Three major types of reinforcement were tried; strip reinforcement over transverse joints only; strip reinforcement over longitudinal joints; and a continuous reinforcement which extends over the whole of the concrete roadway and a short distance beyond the longitudinal edges of the slabs. Previous small test installations, using strip reinforcement, had indicated that the strip width of 3 to 4 ft is not always sufficient to curb crack reflection, and the crack will be transferred to the edge of the reinforcement. An average width of reinforcement of 7 ft was used for the transverse joints.

In the cases of the reinforcement over transverse joints, all the test sections had cracks after two years, but in all cases the number of cracks was less than in the control sections by about 60 per cent. The best resistance to reflection cracking was by 3 in by 6 in mesh of 10/10 gauge continuous welded wire fabric reinforcement in rolls; only 9 per cent of the total length of potential transverse cracks appeared, which was about one-eighth of what appeared in the control section, and only about four per cent were more than ⅛ in wide. The longitudinal cracking was negligible. In strip reinforcement, the best result was given using a band of 6 in by 6 in. mesh of 8/8 gauge welded wire fabric 7½ ft wide. Strip reinforcement was found to require a balanced design—not too strong, not too weak—where relatively large horizontal openings were expected. It was also found that the minimum wire fabric spacing in the mesh should be at least twice and preferably three times the maximum dimension of the aggregate.

Good Building Design Delineated

The Building Research Station have now completed their work on volume II of *Principles of Modern Building—Floors and Roofs* and it is published for the Department of Scientific and Industrial Research by HM Stationery Office (17*s* 6*d*, by post 18*s* 5*d*; $3.15 in the USA). It is a companion volume to that issued in November, 1959, dealing with the principles of design and functional requirements of buildings as a whole, and in particular of walls.

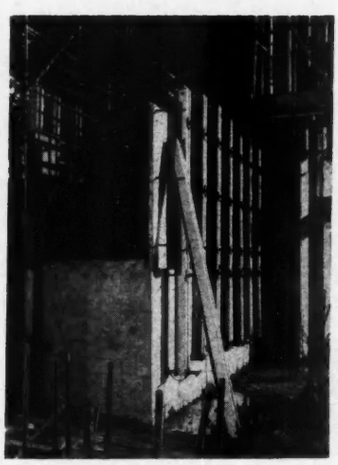
The present volume, like volume I, will be of most use to the architect or designer who has to lay out details on the drawing board; only a short introductory chapter is concerned with stability and structural analysis. Basic requirements common to both floors and roofs, such as sound and thermal insulation, durability, resistance to fire and ease of maintenance are also reviewed in the opening chapters. Thereafter, the more specific requirements of the different types of floor and roof are considered in detail. Chapters are included on floor finishes and on the constructional requirements of floor heating.

Suspended floors and solid floors on the ground are dealt with under separate headings, as also are flat, pitched and shell roofs.

The text and the illustrations are backed by the authority of the Building Research Station and, like the earlier volume, volume II forms an unsurpassed reference work to good building design.

Aluminium Soldiers for Deep Concrete Lifts

Aluminium "soldiers" are being used with advantage to support the shuttering for the concrete shields of the reactors at the Sizewell nuclear power station, where the main civil contractors are Taylor Woodrow Construction Limited. The minimum thickness of the walls is 5 ft 6 in and the concrete is required to be placed with great accuracy and to have a very high surface finish; the shuttering is made up into sections weighing up to 5 tons which is lifted into position by crane.



Aluminium "soldiers" supporting shutterwork at Sizewell power station.

The soldiers—shown in the illustration—are made of James Booth aluminium channel which, though 10 ft long, because of their light weight, have cut labour costs in fixing the shuttering. Lengths of the channel are used back-to-back with a central spacer for the insertion of fixing bolts. As each section of the wall is built upwards, fixing points are left to which to attach the bolts. The walls are poured in 5 ft lifts. The channel employed is of 5 in by 2½ in by 3·54 lb per ft section coated with zinc chromate.

James Booth (Aluminium) Limited, Kitts Green, Birmingham 33.

New Aluminium Sheets Save Costs

Four additions to the range of Rigidal roofing and cladding systems have been introduced by the British Aluminium Company Limited. A new trough sheet, Rigidal Industrial Type C, has been developed. It has a symmetrical profile with troughs 2½ in deep at a pitch of 6 in, the deeper troughs giving the sheet increased strength and stiffness to enable greater spans to be covered; the sheet is 0·048 in thick and will span 15 ft. It can be supplied in maximum lengths of 16 ft 3 in with a maximum width of 7 troughs covering 42 in. The sheet may also be Alocromed and stucco embossed.

Although the Type C sheet uses more metal in a given area than other types of Rigidal roofing sheet, since it can cover larger spans, it is possible to economize in the supporting framework.

A cheaper cladding has been developed in the types WA and WB which are modifications of the standard types A and B; in both cases the pitch of the troughs has been increased to 6 in. It is possible to have a maximum of 9 troughs covering 54 in with a maximum length of 16 ft 3 in.

In the new End Formed Rigidal, it is no longer necessary to have filler blocks. The ends of the sheet are closed downwards at the eaves and upwards at the ridge; the tail length, either flat or formed, is limited to about 3 in maximum.

The British Aluminium Company Limited, Norfolk House, St. James's Square, London SW1.

Technical Manual on Aluminium

The British Aluminium Building Service, supported by the British Aluminium Company Limited and other manufacturers of aluminium building products, has compiled a comprehensive technical manual entitled *Aluminium for Architects*, listing uses of aluminium in the building industry. Copies of the manual have been freely distributed to all likely interested parties. The Service, first begun in July, 1961, has recently been extended to cover all quantity surveying and consulting engineering practices, and will be constantly kept up-to-date and enlarged. The data sheet comprising the manual are classified according to both the SfB and UDC systems.

Stains By-Pass Removes Bottleneck

The opening of the Staines by-pass on the A 30 has removed one of the most heavily congested areas on the main London-Penzance road.

The by-pass, costing £2 million and 2 miles long, has been built with dual 24 ft carriageways which have a design capacity of 2,500 passenger car units per hour. This is expected to cater for all the traffic in the foreseeable future since a lot of this traffic will later be re-routed on the Basingstoke motorway. The western section of the road between the roundabouts at Wraysbury Road and Egham, including the Runnymede Bridge over the Thames, has been designed for eventual widening to dual 36 ft carriageways.

To overcome the hazard of flooding, the road has been constructed on embankments, 20 ft high in certain places. About half a million cu. yd of filling material had to be imported for the embankments and protective fences have been provided where the embankments are more than 10 ft high. At one point, a large area of peat and other material had to be removed.

The Runnymede Bridge was originally designed by the late Sir Edwin Lutyens, but the engineering structure has been completely re-designed by G. W. Glover and Partners, consulting engineers, of London, retaining the original architectural design. The bridge has a single arch span of 173 ft over the river and one small arch span of 31 ft in each shore section. It is of composite construction, incorporating light welded steel arches embedded in concrete, the main arch being of a two pinned type. The width of the bridge between the parapets is 100 ft, and the cellular direct-bearing foundations are carried down into the London blue clay. The soffit and face of the main arch are constructed in white concrete and the parapet is of white Portland stone. A note on the expansion joints in the bridge appears on the opposite page.

Contractors for Roadworks: Richard Costain Limited, Westminster Bridge Road, London SE1.

Standard Portal Frames for New Hangar

The new hangar being built for Channel Airways Limited at Southend airport has a standard steel portal frame obtained from and erected by Sanders and Forster Limited of the Chamberlain Group of companies. The building has a clear span of 134 ft and is 220 ft in length, with a height to the eaves of 20 ft. The roof is of asbestos sheeting and roof lighting is to be obtained through 44 Unilux translucent lights.

Steelwork for Channel Airway's new hangar.

As the hangar is to be used for maintenance purposes, each end is equipped with eight-leaf sliding doors of the bottom roller type, each leaf measuring 18 ft 9 in by 17 ft 3 in wide. When open, these doors are contained by outriggers on the sides of the hangars and entrance is available for the full span of the building. Also fitted in both gable ends are power-operated roller shutter gates 12 ft wide. These will provide the necessary clearance of 32 ft from the floor to accommodate the Douglas Carvair and Vickers Viscount aircraft forming part of the operator's fleet.

The main contractor is Essex Stonecraft Limited of Wickford, Essex, who are now finishing the work after five months on the site.

Sanders and Forster Limited, Warton Road, Stratford, London E15.

Maintenance Free Window Frame

A virtually maintenance-free window frame has been on exhibition at the Building Exhibition at Olympia, London. The frame is of standard Crittall sections covered by a corrosion-resistant plastic skin tightly bonded to the metal; the result is said to be completely rust-proof, require no painting on receipt at site, and subsequently no maintenance for ten years. The coating, between 0·005 in and 0·010 in thick, costs no more than any other rust preventing process.

Tests made at the manufacturer's laboratories, indicate that the range of colours under consideration will last at least ten years. When failure of the coating does occur, the frame could be painted in the usual way.

Crittall Manufacturing Company, Limited, Braintree, Essex.

The Mechanics of the Harvest Underground

The problems of extricating mineral deposits are very much the concern of engineering, and the quantities and varieties sought have led to a wealth of ingenious methods and devices.

WHAT cannot be grown must be mined—an axiom which allows of only the few exceptions proverbially necessary to prove it. Nowhere has it been more apparent that engineering is an original and vital intermediary between material supply and demand than in claiming the hidden mineral riches of the earth.

This claim is one that feeds itself with the products of its own efforts. Coal, iron, oil and diamonds—all have been garnered more and more by machines and all go to make or power them, in the main, before anything else happens. Man makes machines; but not before he has made mining machines. Such devices grew as hand implements to the pick and shovel, now for long the essential in-fighting tools with which to come at grips with the mineral face itself. Engineering growth inevitably had the most pronounced and immediate effect on the building up of an armoury of mechanical aids, until, in current practice, the plant used incorporates a highly diverse array, with equipment making use of virtually every technical principle.

Trend and Adventure

In some countries today, the mining industries represent the paramount economic support. When this state of things occurs with the necessity to develop several kinds of mining interests, a maximum of equipment perfection and utilization becomes essential. Such considerations come to light in a description of the main lines of progress in the mining companies of the Anglo American Corporation Group in South Africa and in Northern and Southern Rhodesia (*Optima*, June 1961). In this the consulting engineers of these companies remark that it is not surprising that there have been many innovations in mining practice, as well as adaptations and developments of methods used in other countries, in Southern Africa, as mining remains the economic stay of the area. "Today the exploitable gold-bearing horizons almost invariably occur at considerable depth. Thus, large capital expenditure is required to bring a modern mine to the revenue producing stage." Speed of exploitation was therefore of first importance, and thus the attention of mining engineers had been focused on the techniques of shaft sinking, on the layout and design of shaft systems and on development.

With the increasing depth of operations in these gold mines, present techniques favour shafts reaching their maximum required depth in a single uninterrupted lift. The chief factor which has affected the ultimate depth has been the mechanical limitation of single-rope double-drum hoists. On the Witwatersrand, underground cooling plants have been steadily improved over the last 30 years, and recent modifications have increased the efficiency of heat exchange in the units.

The process for extracting uranium from local gold ores was developed under the direction of the Transvaal and Orange Free State Chamber of Commerce, the original application of ion exchange to uranium recovery having been developed at the Western Reefs pilot plant. In South West Africa, the alluvial workings at the Consolidated Diamond Mines are highly mechanized operations carried out on a large scale—some 1½ million tons of sand overburden and marine gravels are moved monthly by a fleet of rubber-tyred scrapers and rotary bucket excavators. Recovery of diamonds from the concentrates of the diamond bearing gravels is being undertaken by electrostatic means in addition to the use of grease belts.

Out of the Depths

In Britain, where coal has always been the backbone of industry, much of the mineral lies beneath the sea. The National Coal Board stress the vital necessity of obtaining accurate information about the structure of these coal bearing areas—especially in Durham, Northumberland and East Scotland—well beyond the places where they are worked at present. A new approach to this problem was when the NCB's first sea boring tower was launched from St. David's Harbour on the Fifeshire coast of the Firth of Forth in May, 1955.

Drilling and the recovery of "cores" is carried out as in land operations, but a seal has to be provided against the sea water, and a tubular casing acts as a shield for the drilling rods down into the seabed. The tower carrying the drilling platform is designed for sea depths of up to 100 ft at low tide, and is constructed so as to remain steady in bad weather.

The depths, literally, to which man can go in his quest for what resources lie beneath the earth's crust are illustrated dramatically with what has aptly been called the deepest hole in the world. The surface rocks of the earth have been shown by seismic means to overlie a boundary known as the Mohorovicic discontinuity—some twenty miles beneath most of the land surface. This barrier is much more accessible under the ocean floor, however, and the *New York Herald Tribune* of 12 May this year reported that the "Mohole" test project sponsored by the US National Academy of Sciences had gone a long way towards breaking through this threshold. In April a specially designed drill ship, working through 3,000 feet of water off San Diego, bored more than 1,400 ft into the ocean floor. At Guadalupe, the ship lowered a pipe through 11,700 ft of water and drilled more than 600 ft into the sea bottom. Some of the cores brought up are being examined for signs of hydrocarbon-bearing fossils which may indicate petroleum deposits. It is relevant to the reciprocal nature of mining that the South African company of Industrial Distributors had offered 50,000 carats of industrial diamonds last year for the boring bits used in the Mohole investigations.

Under the Soviet Seven-Year Plan an appreciable increase in oil production is called for, much of which will have to be derived from deep oil bearing strata. In Azarbeidzhan or Baku the present depth of wells does not exceed 4·8 kilometres, but wells of up to 10 kilometres in depth are now being planned. Under these conditions it is anticipated that the oil will be at nearly 1,000 atmospheres pressure and at 300 to 400°C. Drilling pipes will therefore have to be made from special alloys and the hydraulic equipment must be designed for very high pressures. In such very deep drilling, major difficulties are inherent in maintaining the bore axis straight.

Coal in Britain

The National Coal Board in announcing their plans for increased production of coal this year, put much emphasis on the value of more mechanization at the coalface. The power loading of coal, which had eliminated the use of pick and shovel, had progressed so that in 1960 the proportion mined in this way was 38·2 per cent. It was the avowed intention of the Board this year to raise this to 48 per cent: up to 400 new machines were to be installed to increase the power loaded output by 22 million tons. Three machines would lead this drive—the Anderton shearer loader, the trepanner and the coal plough; between them these accounted for 63 per cent of the power loaded total which was recorded as produced in 1960.

In a statement issued in April, the chairman of the NCB, Lord Robens, having referred to developments in cleaning and sorting plants in the general trend to improve the quality of supplies, went on to predict that "Other improvements are not far off, as, for example, the use of gamma rays to detect the amount of dirt in the coal entering the preparation plant. With more automatic control of the plant, a better, more consistent product is produced which is equally important to all our customers, domestic and industrial alike. It keeps down costs."

It is significant to observe how mechanization in the mines has taken over the traditional implements—though perhaps in a more refined guise. Wickman Limited have developed a pick of the slug-insert beak type for application on drum shearers (ENGNG., 21 July, p. 76). This is said to have effected a considerable reduction in the number of picks used by machines.

The Mining Machinery Exhibition at Olympia, London, in July, 1959, found it easier to survey in representative collection the great strides engineering had made in the field. The wooden pit prop had been almost entirely ousted by steel beams—at the coal face itself, the roof could be supported by adjustable hydraulic props, which move forward under power as the cutter advances. The use of compressed air in powering drilling and cutting equipment underground was recognized from its first introduction as having the most acceptable other function of assisting the fresh air supplies to those enclosed spaces. Air under pressure is often applied to reduce the entry of water in tunnelling operations.

Opencast mining, the winning of coal by removing the earth over the coal seam and then working on this mechanically, is employed when the coal is fairly close to the surface. This process requires a minimum of manpower and produces good quality coal cheaply. Since 1942 more than 190 million tons have been produced by this means in the UK.

Safety Factors

There are obvious hazards which the worker underground must face—roof falls, flooding, the incursion of asphyxiating gases and the like. But the superimposition of artificial conditions which highly specialized operation can dictate

Used in off-shore drilling for oil, the Le Tourneau self-elevating barge is towed to location and there raises itself on caissons or spud legs to the required height above sea level.

brings many other dangers in its train. The Safety in Mines Research Establishment, in its thirty-sixth annual report, touched on a range of typical hazards and appropriate precautions—explosives and blasting devices; the explosion hazard itself, of coal dust and methane—the ignition hazard from pyrites; breathing apparatus; the fire hazard, dust control and pneumoconiosis. The director of the establishment, Mr. H. T. Ramsay, M.Sc., M.I.E.E., F.Inst.P., said in his introduction: " There are potential safety advantages in the use of short delay detonators for multi-shot rounds but measures must be taken to overcome the hazard arising when an early shot in the round produces substantial crevices intersecting the holes of subsequent shots, so causing these shots to fire into a break or parting. The problem is facing many mining countries. . . ." In this country it seemed that the best solution was to develop even safer mining explosives.

In the eleventh " W. M. Thornton Lecture," on International Mines Safety Research, given to the Association of Mining Electrical and Mechanical Engineers in June, 1959, by Mr. H. T. Ramsay, the question was posed as to where one should look for further protection against the coal dust explosion. A new method under development in the Safety in Mines Research Establishment employed an aerosol of water droplets containing a small percentage of a binding agent sprayed into the ventilation near a dust source. Having mentioned the preventive measures taken by the NCB in introducing non-flammable conveyor belting—to obviate the risk of ignition by friction, Mr. Ramsay went on to describe the foam-plug fire fighting process. This system aimed to transport the water to the fire in the form of a great mass of foam created and carried by the ventilation currents.

Approach to Demand

Of all coal won in the Soviet Union, 31 per cent is obtained from seams of hard and tough coals. Here, the variety of conditions is considerable, and as a result, 12 different types of power loading and heading machine have been used recently. Cutter loaders of the Donbass-1 type, which are in mass production, have not been very successful in hard and tough coals, but in the medium hardness seams 30 to 36 in thick these machines have won an average of 6,400 tons per month. Shotfiring is more widely employed than undercutting in the tough seams, and design trends which have been initiated for machines of greater capability in the hard conditions include increased capacity, the ability to cut coal on the buttock over a wider area of exposed face and the development of methods of winning which use natural rock pressure to weaken the seam.

A new Russian turbodrill was described last year which is designed to have many advantages over earlier models. It allows remote switching off of the turbine during operations not requiring the tool to continue working, and it is possible to calculate the true value of actual axial loading on the cutter, which is of importance in the control of drilling.

The world's demands for titanium have concentrated attention on the deposits of rutile that occur on the south coast of South Africa. Rutile, a titanium dioxide mineral, also occurs in Australia, the USA and India. The South African mineralized beach sand deposits are mined by high pressure monitoring hoses, and the resulting pulp is pumped to the treatment plant where electrical separation of the concentrates isolates the rutile.

Larger and more efficient machines for opencast mining have been developed. For instance, Europe's largest walking dragline is cited as the Ransomes and Rapier W1800, capable of stripping 300 ft of overburden with a 40 cu. yd bucket operating at 247 ft radius.

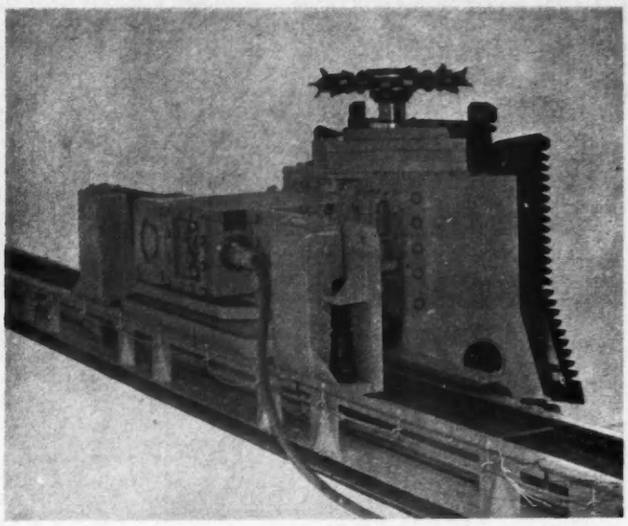
Gasworks *In Situ*

Gasification of coal below ground appeals strongly to the imagination as seeming to have the beauty of simplicity; but it is not a new idea—it was discovered as far back as 1868. A blue book was issued by the Ministry of Fuel and Power in 1956, giving an account of trials in this country since 1949; this volume contained the essentially accurate though oversimplified definition that " the process itself merely involves the passage of air through a burning coal seam to produce a hot, combustible gas which is brought to the surface for use . . .". This gaseous product is a mixture of various gases chiefly composed of carbon monoxide and hydrogen. Both the coal and the resultant coke are gasified: but the end-product is of too low a calorific value for replacement of or admixture with town gas or coke-oven gas. Industrially it can be utilized effectively by burning in a specifically designed chamber or in powering a gas-turbine.

Other countries which have explored underground gasification include Italy, Belgium, France (in Morocco) and the USA. None of these ventures reached commercial proportions and it is only in the USSR that the process has been thus far developed. The Soviet technique, as described by Mr. W. M. Noble, B.Eng.(Min.), M.I.Min.E., Deputy Production Director (Operations) East Midlands Division, NCB, in the *Iron and Coal Trades Review* of 11 September, 1959, has employed three methods of " linkage " —the operation of making the channel in the coal seam: these are the compressed air type, electro linkage and direct drilling. A thorough survey, with many trial holes, is made, and a limited trial scheme precedes a full operation. A typical linkage in the Moscow coalfields, using the compressed air methods, started with 10 in diameter holes being bored vertically into the earth, and lined with 8 in cast iron pipes which went to within 8 in of the bottom of the seam. The linkage was attained by dropping hot coke to the bottom of the pipe which was used for sending air into the seam. After a certain interval, the air flow was reversed by pumping compressed air through another hole—in the instance described the holes being 25 metres apart. In this particular coalfield the air pressure used was approximately 50 lb per sq. in.

In store, the earth has vast reserves of, as it were, " ready-made " consumable gas. Such sources have been intensively evaluated in South West France, for example, at Lacq,where Europe's largest plant for the treatment and distribution of natural gas has been constructed. It has been estimated that by the time the fourth and final stage of this factory comes into production this year, the output will have amounted to 4,000 million cu. m of purified gas annually, in addition to 130,000 tons of propane and butane, 260,000 tons of petrol and 1·4 million tons of sulphur. It is planned to feed refined gas into a network of pipelines reaching to Nantes and Paris, and means that the national imported energy requirements can ultimately be reduced by 10 per cent.

The disclosure of resources in the earth reveals the seed containing the scope of future possibilities; the rate of its growth and realization, and therefore the pattern of progress, depends on the power and efficiency of applied methods and machines.



A plough type of machine now frequently being used in hard coal seams in the UK, the Huwood Slicer is guided by the conveyor which it straddles, and takes a cut of about 12 in in depth. The machine works on the principle of wedging off a slice of coal and then delivering this sideways and up on to the conveyor.

From First to Future

It is fair to say that Cornwall, the home of tin mining since Phoenician times, and renowned for its clay quarrying, has from earliest days led the world in the development of mineral recovery equipment. The introduction of the far-famed Cornish pumping engines was an original and most effective measure to counter the salient hazard of water, which very often threatened to render workings inaccessible; and it was, of course, in the application of steam to power these engines that the world witnessed the efficient harnessing of steam for industrial purposes for the first time.

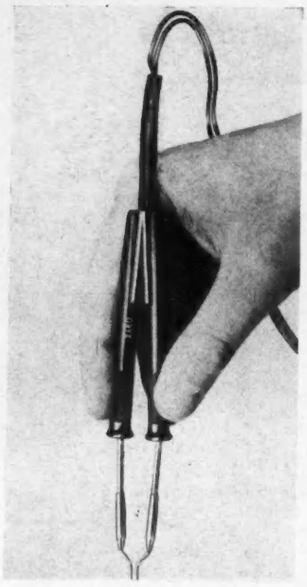
A name fundamentally associated with the pioneering reputation of Cornish mining machinery is that of Holman Bros. Limited, Camborne, Cornwall. The first Holman rock drill was introduced into the Cornish mines in 1881, and the company have since maintained a lead in the design of compressed air operated rock drills. A major advance was in solving the problem of dust-free drilling without the use of water as a damping medium (which is inadmissible in certain conditions, as well as causing discomfort to the operator). In the Holman Short Dryductor Drill the answer was provided by drawing all the dust and chippings created in penetrating the rock back through the hollow drill steel and out through the rear of the machine with a device operated by compressed air power.

The remarks of Mr. R. Annan, M.I.M.M., in introducing the Science Museum exhibition of historic books on mining and kindred subjects, in 1960, provide fitting reflection in a general assessment of prospects, past and present, in the field. " Mining is the second oldest industry in the world, agriculture being the first, and in consequence the profession of mining is of great antiquity. It can be emphasized that in almost every aspect, the forward march of civilization has been based on the miner's skill. It is to be hoped that his skill in extracting such ores as uranium will be directed to helping the peaceful development of the civilization which he has done so much to build."

Great indeed must the responsibilities be which rest on such a basic industry; but equally weighty are the ones which should be borne by those who enjoy the fruits of these perilous labours, in the appreciation of what is involved and what can best be made of the earth's yielding up of its store.

SOLDERING TWEEZERS

Work at Low Voltage



KNOWN as Oryx soldering tweezers, this device introduced for the electronics, wireless and electrical industries, instrument makers and jewellery manufacturers, is now available in Britain.

In the form of a pair of tweezers having $\frac{1}{32}$ in tips, the instrument incorporates separate heating elements in each tip. Instruments are stated to operate at tip temperatures up to 700° F from a 6V supply. It is claimed that ability to heat both sides of a circuit module simultaneously results in work being carried out quicker and that cold joints are virtually eliminated. When working on printed circuit boards the joint may be straddled; this, it is claimed, reduces the likelihood of a pad lifting off. The thermal insulation of the handle is said to result in its always being comfortably cool. The unit weighs but 1 oz. Minimum finger pressure is stated to be necessary. *W. Greenwood Electronics Limited, 677 Finchley Road, London NW2.*

HYDRAULIC PRESS

Steplessly Variable Pressure and Stroke

DEVELOPED from the maker's 7½ ton machine, the Norton hydraulic press illustrated has a capacity of 10 tons.

Compared with the smaller model, the new press is a freestanding one and the power/stroking rate curve is reported to have been smoothed and flattened. The stroke is steplessly variable up to a maximum of 6 in and the dead stops are claimed to allow setting to an accuracy of 0·0005 in. The 3½ in diameter ram, which has four speeds, is fully guided and non-rotating; it is pressure sensitive. Speeds are 47, 141, 282, or 423 in per min. The constant return speed is 459 in per min. Tonnage setting is variable from 250 lb up to the rated maximum. Automatic stroking is said to reach a rate of 940 per min at $\frac{1}{16}$ in stroke length.

Vibratory stroking of variable amplitude frequency (up to 1,500 strokes per min) and tonnage, may be used for vibratory shaving, riveting, and some swaging. Dimensions are: daylight over bed 14 in, over bedplate 16 in; throat 8¼ in. *Frank Lewis and Company (London) Limited, 65 St. Pauls Churchyard, London EC4.*

VARNISH BAKING OVENS

Forced Circulation

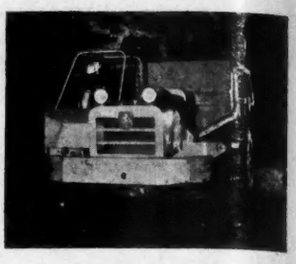
HEDIN electrically heated ovens are available in a range of sizes, with features suiting them to impregnating and stoving varnished electric motors, transformers, and coils.

It is claimed that rapid heating results from the forced air circulation, and that the entire oven chamber can be used without any risk of the radiant heat burning the coil exteriors. Positive evacuation of varnish fumes is said to be provided by an adjustable circulation/recirculation vent. The temperature controller is reported to allow easy adjustment and to give clear indication of the baking temperature up to 250° C. If required a recorder or timer may be incorporated in the control circuit. Safety features provided include an excess temperature cut-out, totally enclosed heaters of low rating, and electrically interlocked fans and heaters. If required explosion relief panels may be fitted to protect the body of the oven.

Twelve different models are available, with internal dimensions varying from 12 in cube to 72 in high by 48 in wide by 48 in deep. Weights vary from 250 lb to 1,900 lb. The example illustrated is No 722; this is 48 in in height and 36 in in width and depth. The rating of this unit is from 7 to 18 kW. If required operating temperatures up to 425° C can be provided. Vertically lifting doors can be embodied. Current requirements are adaptable to customers needs. *Hedin Limited, Commerce Estate, South Woodford, Essex.*

SHUTTLE MINECAR

Driver Faces Direction of Travel



AVELING-BARFORD are now offering a shuttle minecar which has a payload of 10 tons.

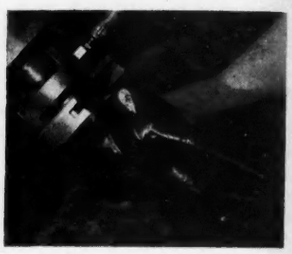
The new unit, which has been developed at the instigation and with the collaboration of Stewarts and Lloyds (Minerals) Limited, has an overall height of 7ft 9 in, in which respect it differs principally from the 10 ton SR shuttle dumper. This height reduction has been attained by altering the position of the seat and controls, by dispensing with drive axle leaf springs, and by using a different body. The latter has an exceptionally low lip at the scow end to enable it to operate with any underground loading machine. Capacity is 7 cu. yd when heaped despite the loading height being but 4 ft 10½ in. To enable the driver to always face the direction of travel the driving seat is reversible and the controls duplicated.

Transmission, giving four forward and two reverse speeds, for speeds between 4·23 and 24·5 mph, is similar to the SR 10 ton model. To meet particular conditions an alternative reduction gear may be incorporated in the drive axle, which reduces road speeds and allows the full range of gears to be used. This is claimed to be advantageous for underground use in that the exhaust discharge has less toxic content than that which would be emitted when using a standard transmission; with the latter the engine would be working hard with no higher gear than, say, third engaged.

The Leyland six-cylinder engine produces 133 bhp; torque is 292 lb-ft at 1,600 rpm. Laden the power: weight ratio is reported to be 6·58 hp per short ton. *Aveling-Barford Limited, Grantham, Lincolnshire.*

PLUG COCK

Easily Cleaned in Position



MADE for use in pipelines in which hygienic conditions must prevail, the Metior plug cock is claimed to contain no bacteria traps or stagnation points, and to be leakproof.

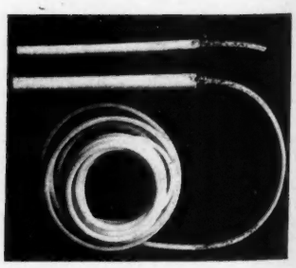
It is reported that the cock has been made for in-place cleaning, and that it can be opened from either the top or bottom. Full bore flow is stated to be given. Should the plug become tight in the body, it is said to be easily relieved by loosening the top cap and tightening the bottom cap. This lifts the tapered plug from the body and prevents the possibility of the plug picking up in the cock body. Friction between body and plug is reported to be at a minimum as the latter is suspended between two compressible sealing rings, the pressure of which on the plug is individually adjustable by rotating the top and bottom caps.

The ptfe joint rings are said to withstand working temperatures of up to 250° C, while the plug cock will hold pressures up to 60 lb per sq. in. The joint rings are normally of the material stated, but if preferred neoprene or rubber rings can be supplied. Two- and three-way cocks are offered. Four odd pipe sizes are available, 1, 1½, 2, and 2½ in and connections fit the makers' range of stainless steel fittings; this material is also the standard material of the plug and body.

Cleaning is claimed to be easily accomplished. It is said that no spanners are required as both end caps may be removed by lightly tapping the wing lugs with a rubber mallet. The cock is applicable to various types of installations. *Talbot Stead Tube Company Limited, Green Lane, Walsall, Staffordshire.*

PIEZOMETERS

Record Levels Above or Below Ground



TWO standard sizes of Endev piezometers are available, both are 18 in long, diameters being 1 in and 1½ in.

Direct measurement of sub-surface water pressure is obtained by burying the porous element at the ground depth at which it is desired to record water pressure. Groundwater enters the element and rises up the connected tubing, stabilizing itself at an elevation dependent upon the water pressure at the point where the element is located. Water pressure in excess of ground level is read on a manometer or pressure gauge; should the level be below ground, the tubing is plumbed to ascertain the level. Modified, these elements may also be used to measure the porewater pressure in high embankments and earth dams. Current practice is to use an element with two leads, allowing water to be circulated through the element after installation; this is stated to give full saturation and accurate measurement.

The element consists of a porous plastic tube, filled with compacted sand uniformly graded. One end of the tube is plugged and the other coupled to the lead-in tube. The average pore size of the porous plastic is 50 microns, enabling the material, it is reported, to be used in direct contact with silt or clay without clogging. It is said that the plastic is free from embrittlement above −90° F and that lightly stressed components of the unit will not distort at temperatures below 212° F. The presence of sand in the tube prevents it from becoming crushed.

Standard couplings are for tubing of ½ in diameter but special sizes can be fitted. *Endev Engineering Developments, 5 Brayton Avenue, Manchester 20.*

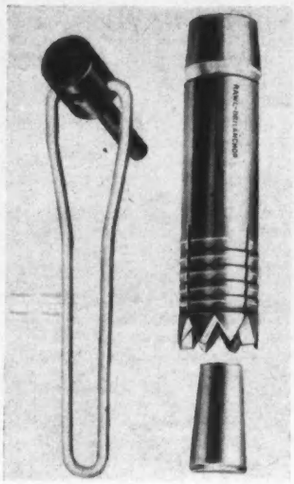
SELF-DRILLING ANCHOR

Quickly Installed

BRITISH-MADE, the Rawlplug Drilanchor is claimed to be an improvement on a type of fixing which has been marketed for many years in America.

This type of self-drilling shield, which is cadmium plated, is claimed to be suitable for applications where maximum strength of fixing is of secondary importance to speed of installation, or where no facilities exist for boring holes in masonry. Drilanchors are recommended only when a few bolt fixings have to be made in hard masonry and the initial cost of a suitable drill may not be warranted.

The shield is entered into the masonry either by inserting it into a holder and striking and rotating it, or by holding it in an adaptor, illustrated, in conjunction with a power-operated hammer. When the hole has been drilled to the necessary depth the shield is withdrawn and a hardened steel expander cone inserted in the toothed end of the shield. When the shield is reinserted in the hole and hammered down, the cone expands the



shield anchoring it in position. The tapered outer end is then snapped off. *Rawlplug Company Limited, Cromwell Road, London SW7.*

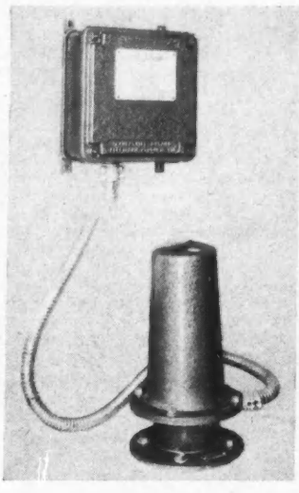
LEVEL CONTROL

Applicable to Deep Containers

DESIGNED to provide single or two point control of liquid levels, the Autodip Series RLC 1 equipment is stated to be without limits on the length of the probe (fitted into the head illustrated) which may be constructed of any electrically conductive material appropriate to the liquid involved.

It is claimed that the equipment may be integrated into schemes for automatic control of pumps, sluices, and penstocks. Operation is on the principle of the measurement of the electrical resistance between a probe and earth. This resistance, which changes substantially when a liquid is in contact with the probe, is measured and the resultant signal amplified and employed to energize a relay. The equipment operates for resistance changes up to 500,000 Ω which is sufficient to cover most conductive liquids.

Operation is substantially independent of supply voltage. The internal relay is fitted with both normally open and normally closed contacts, such contacts



being rated for non-inductive loads at 5A 230V or 1A 440V 50/60 c/s. *Lancashire Dynamo Electronic Products Limited, Rugeley, Staffs.*

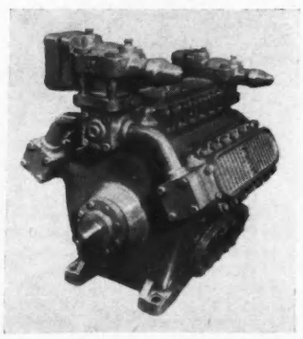
COMPRESSORS

Individual Cylinder Unloading

YORK compressor units of 5 to 30 hp for refrigerant 12, and from 10 to 50 hp for refrigerant 22, are now being supplied.

The principal feature is claimed to be individual cylinder unloading, automatically accomplished by an internal capacity control valve; this is said to permit wide flexibility of operation. The step-by-step capacity control made possible in air conditioning installations is said to be of particular value. Suitable for use with remote condensing equipment, to meet refrigeration requirements in the 5 to 60 ton range, the compressors have 3, 6, or 9 cylinders of 2⅛ in bore by 2¼ in stroke. Operation is in the speed range of 900 to 1,750 rpm, drive being either direct in the case of six models or through V-belt in the case of 17 models.

Static and dynamic balance are such that upper floor mounting is reported to be possible without special foundations. Large ring plate valves are said to minimize chatter and the large suction chamber is claimed to reduce pulsation.



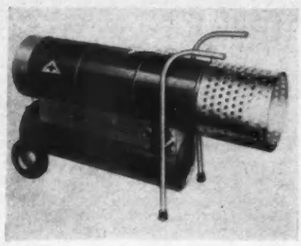
The compressor housing is of high-grade cast iron, with inserted cast iron cylinder sleeves. The aluminium alloy pistons have one compression and one oil ring. Forced lubrication is by a self-priming, self-reversing gear type pump; this feeds lubricant through drilled oil passages and, in addition to supplying bearing surfaces provides oil for the capacity control system. High- and low-pressure cutouts are included. *York Shipley Limited, North Circular Road, London NW2.*

SPACE HEATER

Direct Fired Oilburning Unit

DESIGNED round the Solar Glow flame filter, the D40 oilburning space heater is an addition to the Silent Glow range of such heaters.

Mounted on rubber-tyred wheels, the unit is reported to be completely mobile and to have an output of 144,000 BTU per hr, with an hourly fuel consumption of 5½ pints. It is claimed that due to the products of combustion being separated within the heater, the outgoing air is completely clean and that there can be no contamination when drying sensitive crops. Fuel is drawn from the built-in fuel tank, which has a capacity of 13 gal, by the oil pump and forced under pressure through the burner nozzle. After atomization and mixture with a controlled volume of air, ignition is effected by electrodes, the whole process being automatic. The blower drives fresh air around the combustion chamber, where it is heated and passes out to the direction in which it is required. The volume of air is approximately 1,100 cu. ft per min. Operation is on a



230V 50 c/s single-phase supply; the motor is of ½ hp. Dimensions of the unit are 47½ in long, 30 in high, and 18½ in wide. The weight is 125 lb.

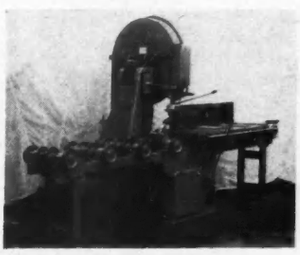
Suggested uses to which the heater can be put are: drying out new buildings, defrosting sand and aggregate for concrete, preheating garages and heating aircraft and vehicles, heating premises and industrial installations, and agricultural purposes including drying crops. If applied to the preheating of large buildings the operating time of the standard heating arrangements can be reduced. *Contractors and Industrial Equipment Limited, 31 Birmingham Street, Oldbury, Birmingham.*

ROLLING TABLE LOGSAW

Suitable for Small Logs

THE STENNER type VJM rolling table bandsaw is said to be particularly suitable for saw-logs of small diameter and also for thinnings. It is additionally claimed to be applicable to secondary operations, handling slabs and offcuts from larger conversion machines.

Features of the machine are: the 3 in wide thin gauge tensioned saw, which is said to produce a kerf normally less than $\frac{1}{16}$ in wide; the individually adjustable lignum block saw guides; the ball bearing table rollers of 6⅜ in diameter; hook dogs which fold away when not required; and a maximum opening from fence to saw line of 10 in. The diameter of the saw pulleys is 36 in; saw straining is done on the top pulley and is applied by a sensitive coil spring device with a graduated indicator. Drive, from a 15 hp motor, is to the bottom pulley through enclosed V-belts. The setting fence is operated by rack and pinion. The fence plate will cant 15° for bevel sawing and is adjustable vertically. Fence opening is shown on a rotating scale.



Rolling tables are provided in lengths of from 6 ft to 20 ft, by increments of 2 ft. The front table is 14 in wide and the other 10 in. The saw is cleaned on both sides by felt pads, lubricated by drip feed. Non-metallic weight-loaded scrapers are used to clean the saw pulleys. Saw guides are adjustable up to 12 in above table level for occasional deep work. Maximum length of saw is 18 ft 4 in. Table height from floor level is 37 in and overall height from floor 7 ft 2 in. Hydraulic feed may be provided, giving infinitely variable feed speeds up to 100 ft per min. The hydraulic equipment fits into the base. *Stenners of Tiverton Limited, Tiverton, Devon.*

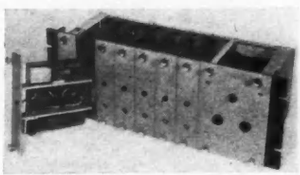
SWITCHING EQUIPMENT

Transistorized

WITH a view to replacing existing conventional mechanical limit switches, and to provide a basis for comprehensive contactless switching systems, Bruce Peebles have introduced a new range of standard transistorized switching equipment.

As all the associated electronic equipment is without moving parts, static switching is regarded as ideal for situations which demand contactless elements. The items comprising the present range of static switching equipment include several types of detector heads and amplifiers, together with nest-chassis units. The example illustrated is a standard 19 in nest-chassis, with one switching amplifier unit withdrawn.

Operation of the switching system is based on the variation of an inductance in the detector head with the approach of a ferrous body. This change is used to unbalance an associated bridge network and the resultant error-voltage output is then fed into a transistor switching amplifier to operate a sealed

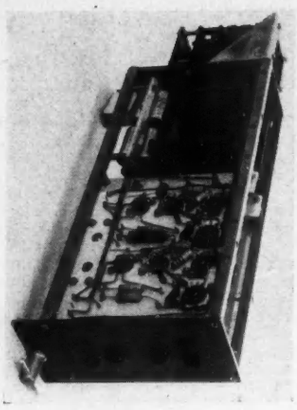


relay for the direct control of the valves, motor starters, or equipment concerned. The proximity detector head can be situated in a position remote from the switching amplifier to eliminate any deviation from the characteristic standard of functional accuracy which may result from extremely high ambient temperatures and stray signals from nearby cables carrying alternating currents.

There are four standard proximity detector heads, with operating ranges of from ½ to 3 in. Any of these can be used with the switch-amplifier unit. The latter units are normally housed in a nest-chassis such as that shown, which can accommodate up to 7 units in addition to a common power supply unit. The normal supply to the detector heads is 24 V 50 c/s. *Bruce Peebles and Company Limited, East Pilton, Edinburgh 5.*

STABILIZED POWER UNIT

Has Separate Outputs



ILLUSTRATED is the Experitron stabilized power unit. This has two separate and independent 300V dc outputs, operating from a 200/240V ac 50 c/s single-phase input. The maximum current available from each output is 200 mA.

Output is stabilized to ±0·2 per cent for nil to full load and simultaneous mains fluctuations of ±5 per cent. Hum and ripple is 15 mV maximum from peak to peak. Outputs may, it is reported, be connected in series for +600V working, −600V working, or ±300V working to earth. Separate LT and HT transformers are fitted with common neutral and independent live inputs for delayed HT switching. Semi-conductor rectifiers, with high piv rating, are used in single phase bridges for the HT supply. No chokes are fitted.

The unit, which is shown on its side with a panel removed, is stated to have all its components readily accessible. Five of these units may be assembled in a standard 19 in rack mounting. Each measures 6 in high, 3½ in wide, and 15½ in deep. Voltage and current monitoring sockets can be fitted. The unit can also be supplied with a variable voltage swing of 200 to 300V at each output. *Experitron, 165 Young Street, Sheffield 1.*

AGRICULTURAL DIESEL ENGINE

Develops 74 bhp

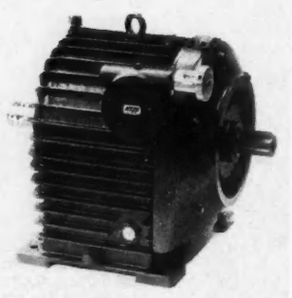
THE Perkins 4·300 agricultural diesel engine, intended for use in combine harvesters and providing more power for medium-wheeled tractors and combines, has a maximum torque of 228 lb-ft developed at 1,100 rpm.

Cylinder block and crankcase are formed from a single high-duty alloy iron casting, the sides of the crankcase being extended below the centre line of the crankshaft to form a stiffening skirt. The four cylinders, which have a bore of 4·5 in, a stroke of 4·75 in, and a total swept volume of 302·2 cu. in, are formed by dry type pressed-in chromium plated steel liners. The rear of the block casting incorporates the flywheel housing flange, the whole block being designed for frameless tractor installation. The two overhead valves per cylinder are push-rod operated. The alloy steel forged crankshaft has induction hardened main and crankpin journals. Chill hardened cams are used on the high-duty cast iron camshaft. The connecting rods, which are molybdenum alloy steel stampings, are provided with replaceable thin walled aluminium-tin lined big-end bearings. Pistons are of high silicon aluminium alloy with three compression rings and two scraper rings. The gudgeon pin is fully floating.

Direct injection is employed, with open toroidal cavity in the piston crown. A multi-hole atomizer is used. Water circulation is by a centrifugal pump. The compression ratio is 17·5:1. Gross output at 2,000 rpm is 74 hp. *F. Perkins Limited, Peterborough, Northants.*

SPEED VARIATOR

Mechanical Friction Drive



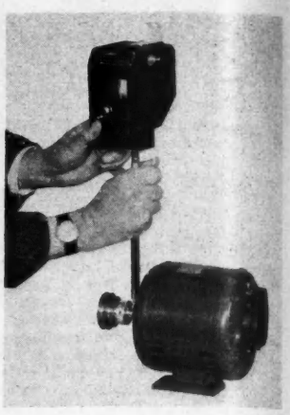
EXHIBITED at the recent Engineering Materials and Design Exhibition, held at Earls Court, the K40 type Kopp variator is an extension of the maker's range.

This form of mechanical friction drive is claimed to have advantages of compactness and high efficiency. The unit illustrated, which has a length of 28 in, is reported to be able to transmit 50 hp at an input speed of 1,440 rpm, giving output speeds between 500 and 2,000 rpm. Alternatively, it will handle 20 hp at the same input speed giving output speeds of between 290 and 2,600 rpm. Depending upon the power to be transmitted, the output speed range has been extended in this new model to 12:1, the minimum output speed being one-seventh of the input speed. This feature is reported to reduce the necessity of employing reduction gears on all but the lowest output speed applications.

The new unit can be mounted either vertically or horizontally; it is obtainable with free shaft ends, as in the example illustrated, or may be coupled to a motor on a common baseplate. Power is transmitted from the input shaft through a pressure device to the drive disc and thence to a series of double conical drive rollers. These rollers rotate on inclined spindles located in a carrier which can be moved axially to vary the speed, by altering the ratio of the diameters of the drive rollers at the points where contact is established. *Allspeeds Limited, Royal Works, PO Box 43 Accrington, Lancashire.*

VIBROGRAPH

Records and Analyses Vibrations



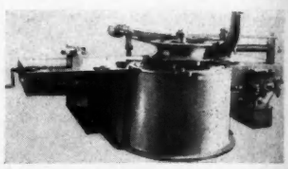
THE Davey hand vibrograph produces permanent records of vibrations. These records are taken on a continuous paper chart over a wide range of frequencies and amplitudes.

It is claimed that accurate measurements result, which may be used to analyse sources and types of vibration. No external supply of power is required. The instrument is quickly loaded or recharged with recording rolls. In operation the unit is held in the hands or rigidly mounted with the pickup pin in contact with the vibrating object. Motion is transmitted through a variable leverage system to a sapphire-pointed stylus, which records the vibration wave form on a moving waxed paper chart. An average test is reported to take about 2 seconds. A timing stylus, actuated by a clockwork motor, makes a notch on the edge of the chart once a second.

Designed to accommodate vibrations of greater intensity than those normally encountered in machinery, the unit has the following operating ranges. Maximum frequency response 15,000 cpm. Maximum displacements: 0·125 in with 5:1 ratio; 0·060 in with 10:1; 0·030 in with 20:1; and 0·015 in with 40:1 ratio. Minimum measurable displacement is 0·0002 in at 40:1 ratio. *C. F. R. Giesler Limited, River Place, Essex Road, London N1.*

PIPE BENDING MACHINE

Also Handles Profiles



THE Hungs-Robie Model RE5 cold pipe bending machine is stated to be able to handle thick-walled ferrous pipes up to 6¼ in od. Non-ferrous pipes up to 7 in od are reported to be within the unit's capacity.

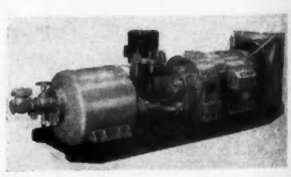
It is claimed that both the bending tool and direction of bending may be quickly and easily changed. Idle running time is said to be reduced by the ability to unclamp the completed work during the return travel of the machine. An electrically operated limit release is stated to ensure exact bending. When the desired degree of bending has been completed return travel is automatically initiated and when the starting position is reached the machine is switched off.

All types of thick- and thin-walled pipes are said to be within the scope of the machine and also solid and profiled material. As all stresses due to bending are taken up in the body of the machine it is claimed that foundation requirements are reduced to a minimum. Maximum bending radius using a mandrel is 39⅜ in. Bending may be performed for radii down to 1·5 times the diameter of the material being worked, depending upon the nature of the material and the internal and external diameter of the tube.

Bending tools are of steel or cast steel; they are available for right- and left-hand bends. Equipment can be supplied for bending spirals and for bending tubes with interlacing bends. The machine is fitted with a device for lubricating the pipe while bending is in progress. Power is derived from a 16 hp squirrel cage motor, driving through V-belts. The supply normally required is a 220/380V 3-phase 50 c/s one; when required, other motors can be supplied. The net weight of the machine with the motor is 3,749 lb. *Pressbend Limited, 28 Marshalsea Road, London SE1.*

ROTARY AIR COMPRESSOR

Electrically Driven



KNOWN as the RE600, the latest addition to the Joy-Sullivan range of compressors has a free air delivery of 600 cfm at 100 lb per sq. in.

Mounted on channel-secton steel skids, with or without flanged wheels, the unit is stated to be particularly suited to use underground, where there is a demand for an easily moved compressor. Use in such conditions obviates the need for lengthy air lines and a large air receiver. The two-stage rotary vane compressor is identical with the Joy Airvane portable compressor of similar capacity. Compressor and motor are coupled through an oil-flooded gearbox, helical gears providing for a speed increase of 0·77 to 1. No clutch is required. The Brush motor develops up to 160 bhp at 1,440 rpm. There is a choice of squirrel cage screen protected, totally enclosed fan cooled, or totally enclosed flameproof motors to Buxton certified standard. Current requirements are 440 to 600V and 2,750 to 3,300V 50 c/s.

Flood lubrication is provided for the compressor and all moving components, the oil being continuously cooled. A fail safe device stops the compressor in the event of the air discharge temperature exceeding 225° F. Units are reported to operate with safety in ambient temperatures up to 125° F. Visual readings are given on the control panel of interstage and final discharge air pressures, and discharge air temperature. Maximum operating pressure is 120 lb per sq. in. Operating speed of the compressor is 1,800 rpm and of the motor 1,440 rpm. Overall length is 11 ft 6 in, overall width 3 ft, and maximum height 4 ft. The weight, including the skid base which for moving in restricted spaces may be split into two sections, is 5,630 lb. The compressor runs at constant speed, unloading being controlled by an air-operated pilot valve. *Joy-Sullivan Limited, Greenock.*

Companies

Chemical Engineering Merger by Steels

SEVERAL subsidiary firms engaged in chemical-engineering work and forming part of STEEL AND COMPANY LIMITED, Sunderland, are to have their activities merged into a new company which will be known as STEELS PROCESS PLANTS LIMITED.

Headquarters of the new concern will be at Steel House, Eastcote, Pinner, Middlesex. They will have available a working capital amounting to £1 million, of which £500,000 will be in issued and fully-paid-up ordinary shares, leaving the balance to be dealt with in the form of loan capital from the parent company as required.

Steels Process Plants will undertake the design, manufacture and installation of large-scale chemical and food-processing plants, in addition to the fabrication of equipment for the gas, petroleum, chemical, nuclear power and other industries.

They are retaining the services of eminent engineers and chemists in a consultative capacity. Another asset to the new firm will be the working arrangements which they have made for exchanging technical knowledge and experience with a number of American and European organizations.

The managing director of Steels Process Plants will be Mr. K. B. Ross, who is to be released from his present position as director of operations to the United Kingdom Atomic Energy Authority's Production Group in order to take up his new responsibilities on 1 January next. He was born in South Africa, where, also, he received his early education. Coming to this country, he continued his education at Exeter College and, as a Rhodes Scholar, at Oxford University, where he gained an honours degree in chemistry. He joined the Anglo-Iranian Oil Company Limited in 1926 and was a director of Costain-John Brown Limited between 1952 and 1954.

New Laboratories to be Opened Next June

Construction work is now in progress by Steel and Company of new laboratories and a test house at the headquarters of the group at Crown Works, Sunderland.

There will be installed in these laboratories full-scale process plants for spray drying, micro-grinding, evaporation, distillation and similar work, so that tests in these directions may be undertaken to assess the value of different kinds of processes or to determine the efficiency of various items of equipment. It is intended that these services shall be available to customers as well as to the firm themselves. Fuller particulars of these facilities will be made known when the laboratories and test house are opened in May, 1962.

Skilled labour and modern plant for the fabrication of sheet, plate and tubes in many metals are available at the company's Sunderland works. Typical of this equipment is the new gas-fired annealing furnace which can deal with fabrications of up to 45 ft by 14 ft by 14 ft and with a temperature of up to 1,050° C.

The recent purchase by Steels of the firm of LUWA A-G, Zürich, Switzerland, who specialize in the production of spray dryers, has contributed towards making the organization one of the leading firms in this field. Their range of spray dryers are now being produced at a recently-constructed factory at Kirkintilloch near Glasgow.

One of the firm's specialities is their range of Ultra-Rotor micro-grinders and classifiers. These are producing the very high grade powders used in many industries, by means of air grinding.

Subsidiary companies are situated in France, Germany, Switzerland, Ghana, Nigeria and India, as well as in Australia, Canada and the United States. They also have their own representatives in most other countries. In short, Steels are now an international concern with their base in Britain.

From Thornycroft to Perkins

It is announced by JOHN I. THORNYCROFT AND COMPANY LIMITED, Smith Square, London SW1, that Mr. H. C. Johnson, their general publicity manager, is to retire at the end of this month after 47 years with the firm.

In future, Thornycroft's press and public relations affairs will be in the hands of Mr. R. T. Mason, while their advertising section will be managed by Mr. J. G. Gunson.

At the age of 70, Mr. Lindsay Hunting has decided to retire from the chairmanship of the HUNTING GROUP of companies, Dunraven Street, London W1, but will retain his connection with the organization as a group director. He will be succeeded as chairman by Mr. C. P. M. Hunting, the present vice-chairman. Mr. Pat Hunting, as he is generally known, is the son of Sir Percy Hunting, himself a former chairman of the group. The organization comprises a number of shipping, oil, aviation, surveying, and general engineering companies.

Mr. N. M. F. Vulliamy, M.A., A.M.I.Mech.E., has been appointed chief engineer (diesel) to the PERKINS GROUP of companies, Peterborough. He is succeeded as manager of the group's experimental department by Mr. A. M. Porkess, A.M.I.Mech.E.

The parent company of the group is F. PERKINS LIMITED, whose principal works are at Eastfield Factory, Peterborough, Northamptonshire.

From Steinmuller to Cochrane

Exclusive manufacturing rights in the United Kingdom for the Steinmuller system of evaporative cooling as applied to open-hearth, reheating, and various other types of furnaces have been acquired by COCHRANE AND COMPANY, ANNAN, LIMITED, boiler makers, Annan, Scotland.

The firm of L. & C. STEINMULLER, Gummersbach, Germany, who pioneered evaporative cooling techniques in that country, were also the manufacturers of the first cooling units of this nature to be used in Great Britain.

These units, operating in conjunction with a waste-heat boiler supplied by Cochrane, were installed at the Temple-borough Works of United Steel Companies Limited.

Cochranes already have considerable experience in waste-heat recovery from industrial furnaces. As a result of the newly-completed arrangements with Steinmuller, they are now in a position to handle complete evaporative cooling systems, either in conjunction with waste-heat boilers or separately.

From the Soviet to the Commonwealth

An agreement for the distribution of an extensive range of Russian welding equipment in the United States and most countries of the British Commonwealth has been concluded by Sir Alfred Owen, C.B.E., on behalf of the OWEN ORGANIZATION, with V/O MACHINO-EXPORT of Moscow.

The agreement originated from contacts made during the course of the British Trade Fair in Moscow and the Soviet Exhibition at Earls Court, London. As a result of the relationships then established, the Owen Organization have made considerable progress in their endeavours to further East-West trade. The agreement now reached regarding welding equipment is but a part of a programme to increase this trade now under discussion with the Soviet trade authorities.

The Owen Organization is a group of more than 50 companies with interests in almost all countries overseas as well as in Britain. The parent firm are Rubery, Owen and Company Limited, Darlaston, South Staffordshire.

Rubber Boots Galore by BTR Industries

Very large numbers of rubber boots of various kinds are now being produced in this country and demands for this type of footwear appear to be increasing considerably.

Among British producers are BTR INDUSTRIES LIMITED, British thermoplastics and rubber manufacturers, of Vincent Square, London SW1. They supply an extensive range of safety rubber boots, many of them incorporating internal or external steel toe-caps to provide additional protection, for persons engaged in light and heavy industry, agriculture, fishing and similar pursuits.

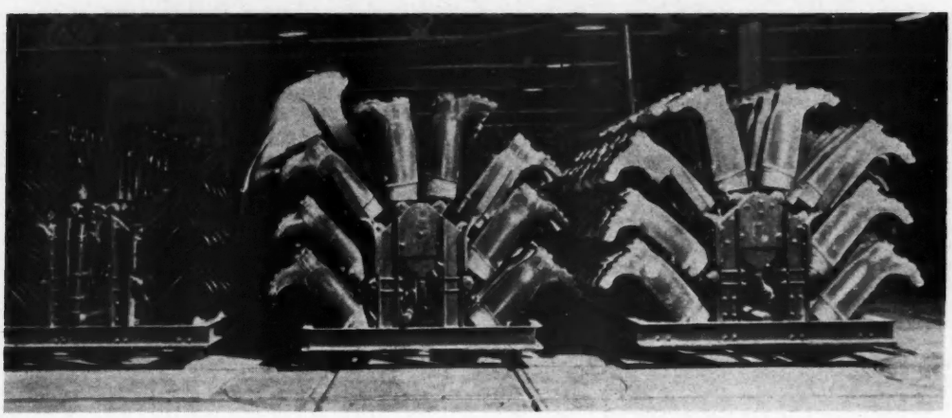
The accompanying photograph shows industrial rubber boots being loaded on to a curing car at the firm's Derby Road factory at Burton-on-Trent, prior to their vulcanization.

BRITISH MOULDED HOSE COMPANY, LIMITED, one of BTR Industries' subsidiaries, were able to resume full production of long-length moulded and braided hose at their Watford factory several weeks ago, following the fire there on 21 June. Productivity has now reached an even higher level than previously.

Nuclear Graphite Production

The AEI-JOHN THOMPSON NUCLEAR ENERGY COMPANY LIMITED, who already hold 50 per cent of the shares of NUCLEAR GRAPHITE LIMITED, are to acquire the remaining 50 per cent from the MORGAN CRUCIBLE COMPANY LIMITED. As a result of this transaction, Nuclear Graphite will become a wholly-owned subsidiary of AEI-John Thompson.

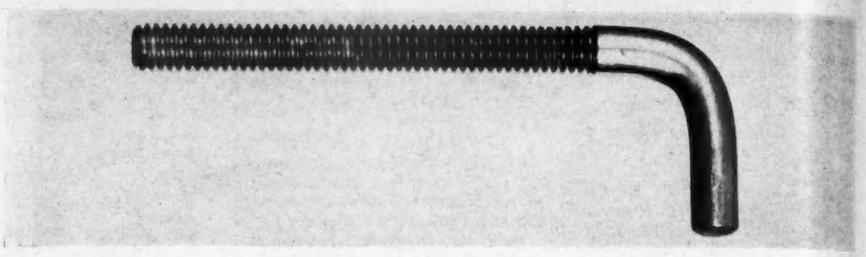
Nuclear Graphite was formed in 1957, with works at Poole in Dorset, to undertake the machining of moderator graphite for the Calder Hall type of nuclear reactor. The company supplied machined graphite for Berkeley nuclear power station, as sub-contractors to the Nuclear Power Group, of which AEI-John Thompson are members. They will also supply machined graphite for Dungeness and other nuclear power stations to be built by the group.



Loading rubber boots on to a curing car, prior to their vulcanization, at the Derby Road factory at Burton-on-Trent of BTR Industries Limited. This firm produce a wide range of industrial rubber boots, many of them incorporating steel toe-pieces.

Experience of Free-Machining Aluminium

Alcan Industries relate how one of their customers uses a free-machining alloy of aluminium and so effects savings over brass.



Example 1 (above) and 2 (below).

DURING recent years considerable experience has been gained in the use of free-cutting aluminium alloys for the production of repetition machined parts. From this it is apparent that such materials, specifically formulated for their machining characteristics, can be the means of making substantial reductions in costs.

Though all aluminium alloys can be successfully machined by using the correct techniques, some of them are unsuited to automatic machine work. The higher-strength alloys machine well, but pure aluminium and the softer alloys tend to be "sticky," building up on the tool edge and producing long unbroken swarf. These characteristics make high-speed production difficult, especially on multi-spindle machines.

Of the aluminium alloys developed to suit repetition work, one that has been used to a considerable extent is Noral 28S. This is an alloy containing 5 per cent copper, with lead and bismuth to confer the free-machining qualities, and is one of the extensive range produced by Alcan Industries. When machined, the alloy forms small brittle chips, which do not have any tendency to tangle around the tool and the work. There is no danger of swarf interfering with the carrying out of a rapid sequence of operations, and much less tendency for metal to build up on the tool edge. In its other properties the alloy is comparable with those generally used for forgings and similar components in aircraft construction; it has an ultimate tensile strength of 20 to 22 tons per sq. in, with a proof stress of approximately 19 tons per sq. in. This compares favourably with free-cutting brass, and the proof stress is similar to the value for free-cutting steel.

Probably the most important point about a free-cutting aluminium alloy such as Noral 28S is its economy. Noral 28S costs, volume-for-volume, approximately half as much as free-cutting brass. Since its density is only about one third that of brass or steel, three times as many components can be manufactured from the alloy as from the same weight of the other two metals. It can generally be machined at the highest speeds available, and in fact special high-speed machine tools are being introduced.

The economies that can be achieved by using free-cutting aluminium alloys depend on a number of factors, which include the complexity of the machining involved, the proportion of scrap machined from the bar stock, the size of the component, and other considerations. It is difficult to lay down any hard and fast rules, but in most instances the savings made by using Noral 28S, as compared with brass, vary inversely with the amount of material removed—that is, a greater saving is likely to be found in the case of say a spindle with a very limited amount of machining at one end, as against a drilled-out bushing with a high percentage of metal removed. In a comparison with steel the converse is true, greater amounts of machining tending to increase the price advantage of the aluminium.

The fact that this general rule does not always apply in practice will be apparent from the following examples, all of which are typical automatic machine production items manufactured by Griffiths, Gilbart, Lloyd and Company of Hockley, Birmingham.

Savings in Cost

Example 1.—The $\frac{3}{16}$ in L-shaped screw, $2\frac{3}{4}$ in long, is for use with a bathroom fitting. The 16 per cent saving made possible by going over to aluminium means a gain of 5*s* 5*d* per gross.

Example 2.—This tapered dowel pin, produced in quantities of 100 gross, shows a saving over brass of 9 per cent, or 1*s* 7*d* per gross.

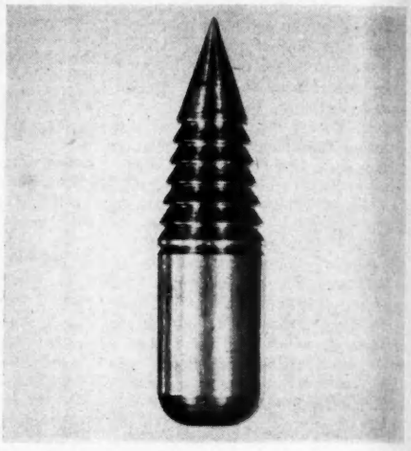
Example 3.—In the case of this $\frac{3}{8}$ in screwed stud (an electrical component), there is an 18 per cent saving, amounting to 6*s* 9*d* per gross.

Example 4.—The hexagon bush, produced in batches of 20,000, can be made in free-cutting aluminium alloy at a cost 26 per cent lower than in brass, giving a saving of 28*s* 11*d* per gross.

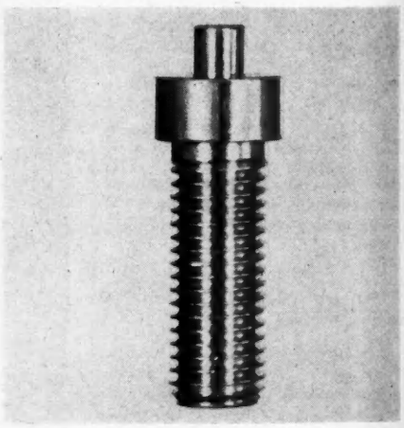
Examples 5 and 6.—These two hexagon-headed set screws ($\frac{3}{8}$ in and $\frac{1}{2}$ in) illustrate the point that it is difficult to apply a precise formula for determining the potential cost reduction. Though the smaller screw works out at 13 per cent cheaper in free-cutting aluminium, saving 5*s* 2*d* on every gross, the larger one shows a 24 per cent reduction, giving a saving of 22*s* 10*d* per gross.

An important feature of these price comparisons is that, since 1 lb of aluminium provides as many parts as 3 lb of brass, they are based on the price of 3 cwt of brass, and on the price of only 1 cwt of aluminium. Production on a larger scale would almost certainly allow the aluminium to be obtained at a lower price, giving higher savings. Furthermore, where advantage can be taken of the higher machining speeds of Noral 28S, the saving in cost of the finished article is further enhanced.

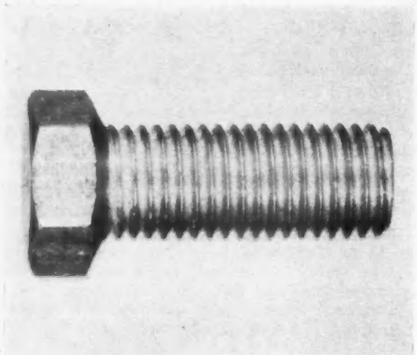
Alcan Industries Limited, Banbury, Oxon.



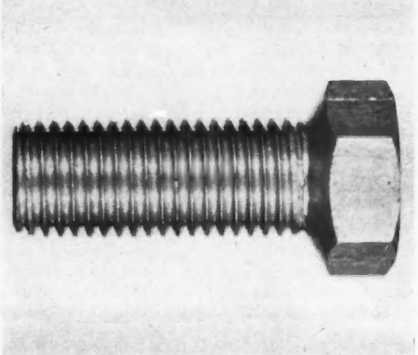
Example 3.



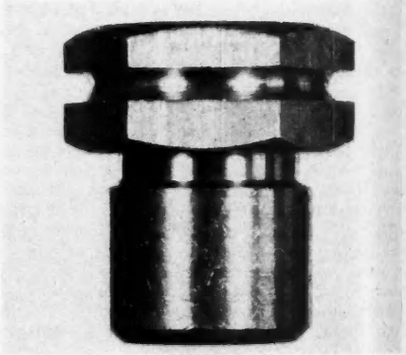
Example 4.



Example 6.



Example 5.



Polyethylene Pipe Standard Changes

A revised British Standard for polyethylene pipe (type 425) for cold water services has just been published (BS1972:1961). According to the new edition, manufacturers of such pipe must apply to the British Standards Institution for a licence to use the Kite-mark if they want to label the pipe as conforming to BS1972. This mandatory requirement, comment BSI, is designed to prevent any false claims of compliance with the standard.

Apart from this requirement, the new edition is technically identical with the 1953 edition. The designation of 425 is an indication of the recommended working stress in the material in lb per sq. in at 20° C when in pipe form. This stress has been used as the basis for calculating the minimum wall thicknesses.

Obtainable from British Standards Institution, 2 Park Street, London W1. Price 4s 6d.

Fireproof Solvent for Cold Cleaning

ICI say they have completed a plant at Widnes, Lancashire, to make a solvent with the chemical formula of 1.1.1.-trichlorethane. This, they say has not been previously manufactured in the United Kingdom. The solvent will be sold under the name Genklene.

Genklene is said by ICI to be non-inflammable and of medium volatility and low toxicity, thus suiting it for cold cleaning. They say it is likely to become widely used for cleaning machinery *in situ* without dismantling, and for many routine production and maintenance jobs. The solvent can be applied by wiping, dipping or spraying, and contaminated solvent can be purified by distillation for re-use if required.

In addition to its use for cleaning, ICI expect that it will find an application as a solvent in adhesive compositions, in the formulation of cutting oils and for the spotting of textiles.

Imperial Chemical Industries Limited, Millbank, London SW1.

Fibre Board Aids in Pressing

An aircraft firm which uses a drop hammer to make pressings in sheet metal has found it advantageous to make use of Essex board. An

example of their technique is shown in the illustration. It can be seen that sheets of Essex compressed fibre board have been stacked on top of the sheet being pressed. When the hammer falls, the boards prevent full travel. By removing a sheet of board at each hammer stroke the sheet is gradually worked to the required shape.

Unless the metal is annealed between hammer strokes there is little reason for expecting much deeper pressings than could be obtained in one operation, given sufficient energy in the hammer. The Essex board almost certainly aids drawing by applying even pressure to the surrounding sheet as would be applied in a normal sheet metal press.

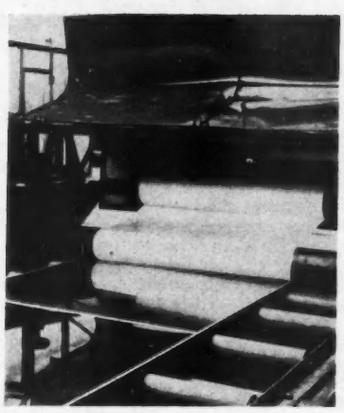
The aircraft firm is Vickers-Armstrongs (Aircraft) and the Essex board which they use is made by Thames Board Mills.

Thames Board Mills Limited, Purfleet, Essex.

Protected Stainless Steel Sheets

Polished stainless steel sheets supplied by Firth-Vickers can now be obtained from them covered with either a low-tack pvc film or with a latex-backed paper film. Firth-Vickers have built a machine which they say can deal with the widest sheets now made up to any length. At the moment the maximum width of the paper protection is 48 in and that of the pvc film is only half this, so that 48 in wide sheets are covered with two strips of pvc.

Although these two protective materials provide suitable protection against most forms of damage, comment Firth-Vickers, there is doubt about their suitability for press work. The best compromise at present seems to be for protected



sheets to be used up to the stage of the out blanks being pressed. This ensures that up to that moment the blanks are free from scratches and abrasions. The protective tape should be removed at this stage and pressing continued using either a loose film of polyethylene or some press lubricant to minimize scoring by the press tools. Results from using thin polyethylene film for this purpose seem to be encouraging, say Firth-Vickers, and the possibilities are being explored of producing a thin adhesive tape having the protective characteristics of pvc with the greater plasticity of polyethylene. Such a tape could then be used both for protection in handling and through the press operations.

Firth-Vickers Stainless Steels Limited, Sheffield.

12 in Nylon Ropes for Tema Harbour

Nylon ropes of 12 in circumference, which British Nylon Spinners say are equal to the biggest ever made in Britain, have recently been put into use in the new harbour at Tema, Ghana. They have a breaking load of 126 tons and are being used as harbour springs.

Two 120 fathom coils of this rope were supplied by the Gourock Ropework Company of Port Glasgow. Each weighs about 27 cwt. British Nylon Spinners comment that besides being immensely strong, the nylon ropes are much smaller and lighter in weight than any natural fibre rope which could be used for this purpose and they are consequently easier to handle.

In the illustration can be seen a 5,000 ton Israeli tanker being secured at Tema by a wire-

and-spring mooring, the spring being made from the 12 in nylon rope.

British Nylon Spinners Limited, 68 Knightsbridge, London SW1.

Gloves Safe in Hydrocarbons

Gloves made from nitrile rubber latex on a stockinette fabric base are being produced by Chichester Rubber Company. These are said to be the first ones commercially available in this material and to be superior to natural rubber and synthetic rubbers in some conditions.

British Geon, suppliers of the nitrile rubber latex, say that the gloves are resistant to a wide range of greases, oils, solvents and acids, and in particular can be safely used with hydrocarbons. Insulation resistance is said to be such that solid carbon dioxide can be handled in the gloves. The stockinette base allows gloves to be with-

drawn without difficulty in an emergency. The gloves are available in men's sizes 8½ and 9½.

Chichester Rubber Company Limited, Dunstable, Bedfordshire.

British Geon Limited, Devonshire House, Piccadilly, London W1.

A Chain Reaction in Technical Advance

Advances in steel production in the last decade have necessitated developments and adaptations in the manufacture of a variety of production plant. To meet the gradual replacement of cast iron mill rolls with steel base rolls, for many applications, one manufacturer has made an interesting adaptation to his furnace equipment.

IN ORDER to extend their production capacity for steel base mill rolls, Josiah Guest and Sons, long established manufacturers of cast iron rolls, have made basic adaptations to their plant. Some of their furnaces were suitable for cast iron only and were hand-fired with solid fuel without any form of temperature indication or control. A new furnace was therefore planned, suitable for the melting of both steel base and cast iron rolls and with semi-automatic oil firing, remotely and automatically controlled in several functions.

It was decided that the specifications of the proposed furnace should be that the melt capacity would be 10 tons and the fuel oil a heavy grade 960 seconds Redwood No. 1 viscosity at 38° C. For high-duty cast iron rolls the furnace should work with a reducing atmosphere throughout the melting cycle. For steel base rolls, provision should be made for an oxidizing atmosphere. The 10 ton melt should take 6 to 7 hours with a target fuel rate of 40 gallons per ton melt.

A top loading reverberatory design was specified with alternative water-cooled side doors, remotely operated through pneumatic power cylinders, for loading returned rolls straight into the furnace from transport. A gantry crane was installed for this purpose and for lifting off the appropriate roof section.

Urquhart's (1926) Limited, of Greenford, Middlesex, won the contract to design, supply and install the furnace, combustion equipment and controls and they, in turn, appointed the Furnace Construction Company, of Birmingham, as sub-contractors for the construction of the actual furnace. Close cooperation was maintained at all stages to ensure full integration of the design of the furnace and the oil-firing equipment. The same sub-contractor also repiled the foundations to take the new furnace and the steel work erected to house the recuperator.

The resulting furnace is shown in a general side view in Fig. 1 below, where the recuperator and the combustion air duct to the registers can be seen.

Recuperator

At some points, it was necessary for the overall design to incorporate equipment already acquired by Josiah Guest. An example of this was the recuperator, a Newton Chambers Inka radiation type capable of preheating the combustion air to approximately 350° C. Its design was such that to remove the tube bundle and exhaust duct, a gantry duct had to be installed. The steel frame housing supporting the recuperator also accommodates a gantry crane, exhaust duct and combustion and cooling air fans. The fans inject cold air into the waste gases at their exit from the furnace in order to keep them below 1,300° C as they enter the recuperator.

Oil Burning Equipment

Some of the oil-burning equipment had also been installed already, including an oil ring main pumping and heating installation, to which only minor modifications were made. It was found necessary to add boost pumps, primary air compressors and a combustion air fan, for a maximum fuel consumption of 120 gallons per hour.

To give maximum heat distribution over the melt two Urquhart Type SFF7 Atomizers (shown, with the air registers, in Fig. 2) are used, each mounted on universally swivelling fixings enabling the angle of firing to be adjusted by 2½ degrees in any plane. The air registers, utilizing preheated air from the combustion air fan via the recuperator, are designed to give maximum mixing of combustion air and fuel, by injection of air into the atomized fuel spray. Although air is supplied from a common source there are trimming dampers on each air register to ensure equal distribution.

To provide atomizing air for the twin MPA atomizers three air compressors were installed, giving a 50 per cent standby. The boost fuel pumps are Urquhart variable angle swash-plate metering pumps and in this case, they combine the function of boosting pressure with that of a completely positive control valve. Three pumps are installed, again providing 50 per cent standby capacity. In addition there is a by-pass system so that the pumps can be excluded and the burners operated on ring main pressure in an emergency.

Control System

The control system can be divided into three parts, namely, (*a*) temperature and atmosphere control; (*b*) furnace pressure control; and (*c*) recuperator inlet waste gas temperature control.

In the first of these parts, temperature and atmosphere control, a radiation pyrometer in the side wall of the furnace and sighted on the furnace crown transmits to a temperature controller. This temperature controller in turn puts out a pneumatic signal in the range 3 to 15 lb per sq. in to both air flow and oil flow controllers. The air flow controller adjusts a valve in the combustion air duct to the recuperator by means of a pneumatic power cylinder. The oil flow controller adjusts the output of the oil metering pumps by variation of their swash-plate angle, through a pneumatic power cylinder and cam shaft.

Oil and combustion air flow is then checked and trimmed by feedback through measurement of air and oil flow. A variable ratio mechanism is provided to allow for the requirement of an oxidizing atmosphere when melting steel and a reducing atmosphere when melting cast iron. Provision is made for over-riding manual control.

Under the second part of the control system, to ensure that the furnace operates under a slight positive pressure a furnace pressure controller is fitted, controlling the position of a damper in the exhaust duct on the discharge side of the recuperator through a pneumatic power cylinder.

For the third part of the control system, a thermocouple positioned in the entry of waste gases from the furnace to the recuperator measures the gas temperature and, through a temperature controller, adjusts the quantity of cooling air injected into the gas stream by variation of a damper in the duct from a cooling fan, connected to a pneumatic power cylinder.

To provide the instrument air supply required, a compressor set is included, comprising one working and one standby compressor, both feeding a single air receiver, installed in the pump and compressor control room. The instruments to effect the controls described are all mounted on a free standing panel, visible from outside the pump room. Fitted into a sub-panel on this main panel are all push buttons and indicating lights for pumps, fans and compressors.

A full light alarm system is incorporated for immediate indication of the source of any fault, and apart from the actual lighting up of the furnace all other starting up or shutting down and control operations may be carried out by one man from this control panel.

Thus, by replanning their furnace facilities, Josiah Guest have a modern and up-to-date plant capable of the closely controlled production of both cast iron and steel base mill rolls.

Josiah Guest and Sons, West Bromwich, Staffs.

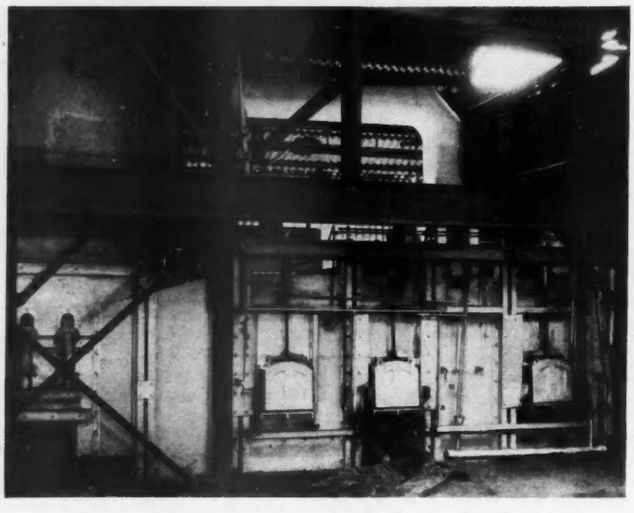


Fig. 1 (left) A general view of the side of the furnace, showing the recuperator (top left) and the combustion air duct (top centre) from the recuperator to the air registers.

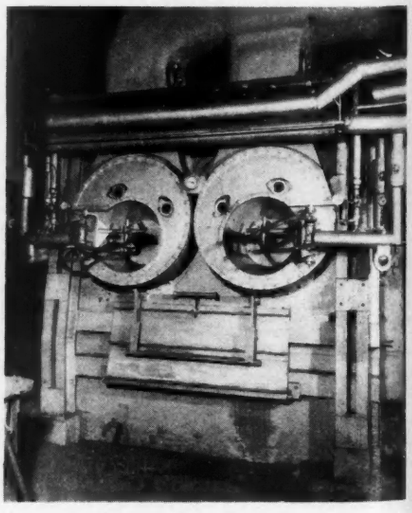


Fig. 2 (right) The atomizers and air registers at the front of the furnace.

Automated Control of Steel Production

The Spencer Steel Works of Richard Thomas and Baldwins, now in an advanced stage of construction at Llanwern, is said to be the first steelworks in the world to be planned with a fully automated system for controlling production from A to Z. This concept of seeing the whole production process as an integrated whole has, while retaining flexibility in individual sections, been made practicable by Elliott-Automation's development work on electronic computers. Earlier control systems have been concerned with individual sections in isolation.

This control system receives a constant flow of demands for a variety of end-products in varying specifications and batch sizes, and converts them into instructions which are broken down and refined by computers in such a way that they can be acted upon appropriately at each level. These control instructions are complemented by technical instructions so that the entire plant operates at optimum efficiency.

Feedback information is transmitted from each section and is assimilated by the computers and compared with the original instructions. This enables each level of control to modify its instructions in the light of actual performance.

The computers, in fact, are organized in the same cybernetic concept and general pattern as the human chain of command in that a number of separate units are able to communicate essential information to each other and, by automatic compensation for any deviation from the original instructions, ensure the efficient overall control of the whole operation.

This development of an automated, self-compensating and flexible system of control of production is likely to have a fundamental effect not only on production engineering but on basic concepts of management. It is particularly significant that this type of computer control should have been evolved in the steel industry, an industry which, probably more than any other, has the problem of controlling a " horizontal " product with a " vertical " management structure.

Elliott-Automation Limited, 34 Portland Place, London W1.

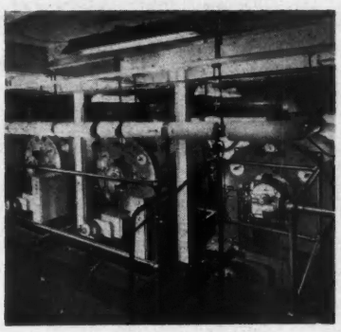
University Press Plant Being Brought Up-to-date

The Oxford University Press, which has been owned by the University and controlled by its Delegates of the Press since 1690, has, obviously, a high reputation for the quality and quantity of its products. Indeed, its publishing business is believed to be the biggest in the world, and it also controls extensive paper manufacture. Not so well known, however, is the fact that the Press endeavours to keep abreast of developments in plant and methods.

A recent example of this last characteristic is the replacement of two economic type boilers with three fully automatic Powermaster packaged boilers (shown in the illustration), a change which greatly improves the efficiency of the steam-raising plant. It was decided to use three boilers in order to make a more efficient balance between the summer and winter loads. This decision was also influenced by the limited access to the boiler house, restricting the size of boiler which could be installed.

The boilers which have been replaced were built in 1903 and had thermal efficiencies of between 40 and 50 per cent, while the new oil-fired Powermaster boilers (ENGNG., Vol. 190, 1960 p. 686) have a guaranteed efficiency of 83 per cent. Each of the package boilers is capable of producing rather more than 4,300 lb of steam per hour running on 960 seconds oil. They are the Model 125 type, and each is 14 ft long, 6 ft 9 in wide, 10 ft high, and weighs 15,400 lb.

The two economic boilers were about 10 ft in diameter by 16 ft long over tube plates and rated at 10,000 lb of steam per hour. Steam is required for space heating, the hot water supply and some process work, and it is estimated that the higher efficiency Powermasters will save over £2,600 a year on fuel costs alone.



The three Model 125 Powermaster installed in the boiler house of the Oxford University Press.

Apart from the saving on fuel, however, a strong argument for the switch to Powermasters was that they are completely self-contained units. The steel internal furnace boiler, the burner, the fuel-handling equipment, the automatic operating and safety controls, the draught fan and motor, and all other accessories are mounted on a robust structural steel base. When delivered, they are ready for immediate operation as soon as fuel, water, electricity and steam connections are completed. Powermasters comply with the most stringent anti-smoke legislation.

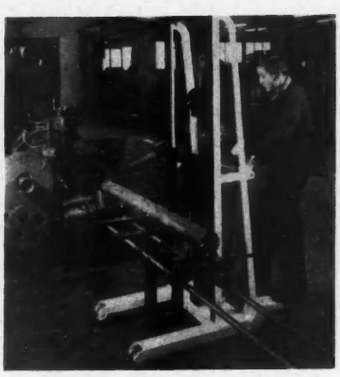
G.W.B. Furnaces Limited, Dibdale Works, Dudley, Worcestershire.

Manoeuvrable Hydraulic Lift Unit

A recently announced hydraulic-lift truck unit, demonstrated in the illustration, has a number of applications in the handling of heavy machine components, billets and pallet trays of small components, on the production shop floor and in the stores. Known as the Polymathic " Coolie," it is of sturdy construction yet, with a full capacity load of 10 cwt at the maximum clearance height of 4 ft 6 in, can be easily manoeuvred by one man. The exceptionally low-slung frame and even weight distribution give the unit very good stability over most types of factory floor.

The hydraulic pump is completely self-contained, does not have any external piping, and is guaranteed for two years. Loads are raised to the required height by a hand lever, and a foot-operated variable speed release valve controls lowering.

There are three alternative types of lifting platform, namely: (*a*) fork lift arms with a 1 ft 8 in reach; (*b*) a steel platform measuring 1 ft 8 in by 1 ft 6 in; and (*c*) a jib arm extending 2 ft 6 in. In the case of the jib arm, the extra overhang restricts the safe maximum weight to a load of 3 cwt. A safety valve prevents operation above the maximum capacity.



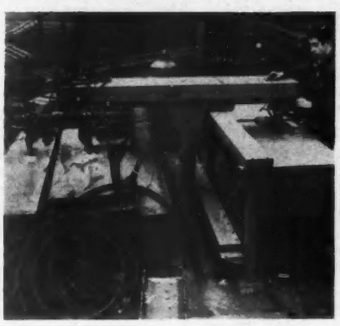
An operator about to lower a billet into position with the " Coolie " hydraulic lift truck.

Having a base only 3 ft 6 in by 2 ft 3½ in and being 6 ft high to the top of the mast, the Coolie can pass through standard doorways and can be guided between and around most machines and storage racks. The standard 4 in diameter wheels have grease packed roller bearings. A number of adaptations to the standard model can be supplied for particular applications.

Polymathic Engineering Company Limited, Tamworth, Staffordshire.

Fabrication Speeded with New Oxy-flame Cutter

The repetition cutting of mild steel flanges, discs and other fabrication components has been made faster and more economic at the Glasgow factory of Clydeside Steel Fabrications by the installation of a precision oxy-flame cutting machine. Increases in production made the existing two multi-head machines insufficient and uneconomic. An SIF 75 Cutamatic oxy-flame cutting machine, as shown in the illustration, was therefore installed.



The SIF 75 Cutamatic oxy-flame cutter.

This new machine has a number of unusual design features and has already been effective in making savings in time and money. It has dual operation from each end of the machine and is operated electrically. The cutting nozzles are mounted on a swivel boom, facilitating rapid adjustment of the nozzle positions, and the machine is equipped with a magnetic tracer for metal templates, facilitating reproduction from such templates of accurate and precision cut units on a mass-production scale. On the other hand, one-off intricate profiles can be cut on heavy material, without the necessity for making metal templates, by using a free-hand tracer.

A retractable table makes work possible on comparatively large profiles, and the multi-head burners will cut profiles up to 6 in with standard burners and up to 12 in with special burners.

An interesting point for those who tend to be cynical about the use and effectiveness of trade exhibitions is that Clydeside Steel Fabrications realized the potential of this cutter after seeing it at this year's Welding Exhibition at Olympia.

Suffolk Iron Foundry (1920) Limited, Stowmarket, Suffolk.

Giant Russian Lathe

It is reported that the Kharkov Turbine Works has just completed the assembly of the biggest ever Russian-made vertical turning lathe. Occupying an area of about 9,700 sq. ft, it weighs over 1,400 tons. It can handle components weighing up to 400 tons and over 65 ft in diameter.

There is push button control, enabling a single operative to operate the lathe, and the ancillary processes are automated. Flexibility is provided by a support for milling, drilling and boring, and by various other devices for other operations.

Soviet Information Service, 3 Rosary Gardens, London SW7.

On the Shelf

By Frank H. Smith

EDITORS of technical journals are often as anonymous and unlauded as he of *The Times* but I see that a guest editorial by Theodore von Kármán in *ARS Journal* of the American Rocket Society is entitled " Martin Summerfield: Ten Years Editor." This Society has grown, both in membership and prestige, probably more than any other technical society in a comparatively short period. Of course, they have the advantage of a particularly attractive bandwagon on which to jump but I understand from American contacts that they also have a very live sense of publicity and public relations. If the number of preprints for national meetings is any criterion, they are more with it than most. The *Journal* has five different sorts of editor, four associate editors, three assistant editors, a director of marketing, an advertising production manager and five advertising reps in different cities, including B. C. Nichols, 151 Fleet Street, London EC4. This compares with a technical society journal with which I am connected where the editorial staff is one editor, one proof-reader and one typist; with a firm of advertising agents to handle publicity matters.

The Library Association is taking a brave step. In 1962 it is publishing *British Technology Index*, described as a cumulative index to British technical periodicals. Six weeks, they reckon, will be the time-lag. Eleven monthly issues (not August) and a cumulative annual volume at 15 guineas or $50. Subjects in ABC order. And I wish 'em joy. Specimen page and order form from: Secretary, Library Association, Chaucer House, Malet Place, London WC1.

Robert Maxwell invites you to " peruse this new bulletin " which is *Pergamon Progress*, listing their latest. The front cover shows " book of the month " which is a mere 20 quids worth. The back cover shows journal of the month, Vol. 1, No. 1 of *Machine Tool Design and Research*.

I am always tickled by those Miss 1970 adverts where oil gives comparative figures for central heating showing how well it shows up against electricity and gas. There is a little footnote about solid fuel giving a lower figure with anthracite but emphasizing the *convenience* of oil. Well, to me £.*s.d.* is all-important and anthracite is not the cheapest solid fuel by a long chalk. The National Coal Board is opening advice centres in various parts of the country and the latest is in Huddersfield. The ceremony was performed by (wait for it) Mr. Sales, chairman of the North Eastern Division of the NCB. What chance has a bloke with a name like mine? There's no Horse Shoe Marketing Board or I might get somewhere.

A week or two back, when Mollie (Molly?) Neal did a review of a book, she was described as a freelance. Can anybody tell me if this should really have been a free distaff? I've never seen the expression but if the opposite of the distaff side of the family is lance (as it is) surely the converse should apply.

In my ignorance I had always thought that " the die is cast " derived from the singular of dice, but now I am not too sure since I have been gazing at *Die Casting News*, a periodical leaflet put out by Zinc Alloy Die Casters Association now in its fifth issue. The applications of these castings really are quite interesting to the untutored. They include the Horstmann battery-operated gas lighter (and gas usually *is* lighter), Shepherd castors (which send you halfway across the room when you plop into an armchair or bed), Hi-fi equipment (which sends oldsters round the bend when it is wielded by teenagers), and the Cona coffee maker (which makes railway refreshment room coffee palatable). The Zinc Alloy Die Casters Association are part of the Zinc Development Association, of 34 Berkeley Square, London W1.

Inspection on the Shop Floor

Elementary Machine-Shop Inspection. By R. C. TATLOW. *Blackie.* (9*s*)

Many books have been written on the subject of engineering inspection and metrology and the treatment of the subject has in general been centred around the principles of operation of precision measuring equipment and the techniques used in a standards room. Books of that type are generally more suitable for the advanced student or the practising metrologist rather than the inspector on the production line.

This book has been written with the needs of the trainee inspector in mind and to that end the author has not only provided him with a wide selection of techniques for dealing with the inspection of components in the production shop but he has also sketched in, in elementary detail, the background knowledge that is essential for efficient inspection.

The simplest way of controlling the dimensions of a machined component is a system of limit gauging; various types of limit gauges are described with examples of their applications. Although the design of limit gauges is obviously outside the scope of a book of this type the author is to be complimented for introducing the reader to " Taylor's Principle " for the design of limit gauges. Knowledge of this principle should help the less experienced inspector to a better understanding of the gauges that he is using and their use in detecting faults that may exist in the part he is checking.

Although the measuring equipment that is used in " shop floor " inspection is of a simple nature the inspector must know the correct way to use it. It is also very important that the inspector should not take the accuracy of this equipment for granted for in even the most precise equipment errors exist. These matters are discussed at length and to enable the reader to extend his knowledge a list of British Standards relating to simple measuring equipment is given at the end of the book.

The duties of the inspector extend beyond the acceptance or rejection of the work on the basis of its dimensional accuracy. He is frequently the first person to discover a defect in the work and since a defect in the work is caused by a defect in the process he should endeavour to locate the cause of the trouble and report it to those who are respnsible for controlling the process. By attention to details of this type the inspector can make a real contribution to the productivity of the works. Examples are given from the author's own experience to emphasize this most important part of the inspector's job.

Other facets of the knowledge required by the inspector such as limit systems, tolerances, surface finish are dealt with and the book ends with two examples of the complete inspection of two simple components.

This little book is written in a clear style and the diagrams are clear and well drawn; they are, in general, on pages adjacent to the relevant text.

The author has produced a very good little book for the embryo inspector which could also be read to advantage by the craft apprentice.

S. DEATH

Welding Practice

Modern Arc Welding Practice. By J. A. OATES. *George Newnes.* (30*s*)

Welding Engineer's Handbook. By J. A. OATES. *George Newnes.* (21*s*)

In a recent report of the International Institute of Welding the courses and requirements for the training of welding personnel were given for this country. A welder, for example, acquires his skill either in his company's welding school or in one of the equipment manufacturers' courses, spending some 90 per cent of the time in practical instruction; the welding technician, on the other hand, will have studied a limited amount of science and technology and is expected to complete a City and Guilds of London syllabus in one of the 150 technical colleges offering three year courses in welding; the welding engineer will probably have first acquired a professional qualification in a branch of engineering or metallurgy before " converting " to welding. The first post-graduate course in welding starts at the College of Aeronautics, Cranfield, this autumn.

Only a limited number of textbooks is available to satisfy the demand created by this intense activity in welding education, although the number of research and development reports published in the world literature increases annually. At the British Welding Research Association some 40 journals, devoted specifically to welding, are received each month, and as many other technical journals carry papers on the metallurgy or application of welding. No one occupying a job other than a sinecure could possibly hope to read the whole welding literature, even if his scientific training were sufficiently wide to let him understand it all.

More books are therefore desperately needed on a range of welding topics, aimed at the various types of worker in the welding field. Much of the welding equipment developed over the past 10 years has achieved a better performance at the cost of simplicity in design so that a comprehensive book dealing with the basic principles of welding processes would be welcome. A handy volume written on modern arc welding practice published in 1961 should therefore contain details of the rapid advances made in the past 10 years, together with references to the long established, familiar processes, giving the fields where the advantages of each process can be exploited.

To the welder, the welding technician and the welding engineer, however, Mr. Oates's book *Modern Arc Welding Practice* will come as a disappointment because the majority of the book is devoted to manual arc welding with covered electrodes. It is difficult to decide on the intended readership of the book since the welding engineer will find no bibliography from which the brief references to a topic can be followed up; the welding technician will find it inadequate for his course needs; and the welder will have most of the material already in the form of the electrode manufacturers' trade literature, collected during and since his training period. Much of the text had a familiar ring to the reviewer and a quick perusal of trade and the development associations' literature on welding was sufficient to identify the origin of many pages of the text.

There is a risk in producing a book on a technical subject if the author is not actively engaged in work on the subject, and the many elementary mistakes bear witness to this. For example, columbium and niobium are given as alternative stabilizers when in fact they are transatlantic equivalents; semi-automatic self-adjusting arc equipment is incorrectly captioned " controlled arc "; a backing bar reproduced from the Copper Development Association's book on welding copper is shown inverted, CO_2 is referred to as " another inert gas "; 5 per cent silicon filler metal is used to make a weld in 99·99 per cent super purity aluminium.

It is on Mr. Oates's treatment of the welding of aluminium that the heaviest criticism falls, since virtually the whole chapter is devoted to metal arc welding with covered electrodes—a practice never adopted if inert gas shielded processes are available. Inert gas shielded processes in general are lightly skipped over and the widely used consumable electrode process is disposed of in less than a page in the chapter

on "Argon Arc Welding." By using the index to find data on the welding of nickel alloys one draws the conclusion that only covered electrode processes are used, which is certainly not the case. This incorrect impression is given by the fact that the author has drawn solely on the Henry Wiggin book on welding nickel alloys—and indeed, only from the chapter on metal arc welding!

It is this sort of unintentionally implied impressions that makes the reviewer uneasy about recommending the book even to the newest apprentice, who will possibly buy the book on the strength of the chapter headings and thus derive a general introduction to the subject. It is a pity that Mr. Oates has drawn only on trade literature and secondhand material to write his book, for by ignoring the very full technical literature it fails to give a modern, comprehensive statement on the subject. The important omissions include mention of the constant potential power sources, tungsten arc cutting, the surge injector, consumable electrode spot welding, automatic tungsten arc length control, argon-oxygen mixtures for steel—all of which have been in use for at least five years.

The companion volume *The Welding Engineer's Handbook*, edited by Mr. Oates, again gives insufficient information on the newer welding processes but some 200 pages are devoted to manual metal arc and oxy-acetylene welding; the remaining 90 pages cover resistance welding and all other developments. The section on "New Welding Processes" occupies only 1½ pages, "Automatic Welding" a mere three pages in which to deal with submerged arc welding, and in the two pages on "Special Arc Welding Processes" three of the seven processes mentioned are obsolete. The section on "Shielded-Arc Welding Processes" (8 pages) is largely reprinted from the Aluminium Development Association's booklet on welding aluminium (published in 1955), and explains the statement that the tungsten arc "welding sets are invariably designed for A.C."—true for aluminium and magnesium but dc is used for all other metals. The inclusion of 50 pages of advertising material within the text may have had something to do with keeping down the price of the book but the interruptions and small type make the book difficult to read. Like the other book under review an index but no bibliography is given.

A. A. SMITH

Landscape and Man

Landscape Architecture. By JOHN ORMSBEE SIMONDS. *F. W. Dodge Corporation, 119 West 40th Street, New York; Iliffe.* (95*s*)

For those who will be responsible for the layout and site planning of our new towns, universities, hospitals and schools, this book has arrived at an opportune time. It is not a textbook. It includes nothing on arboriculture, soil treatment or traffic engineering. It is a stimulating treatise by a master craftsman on the philosophy of landscape planning. The argument is supported by many deep and pertinent quotations and is lavishly illustrated with well chosen photographs and pithy sketches.

John Ormsbee Simonds is a partner of the firms Collins, Simonds and Simonds of Washington, DC, and of Simonds and Simonds of Pittsburgh, and has had a hand in such important projects as the North Triangle Redevelopment, Philadelphia; the Pittsburgh Civic Amphitheatre; Mellon Square, Pittsburgh; the Allegheny Centre Redevelopment and the new Annapolis Campus. In recent years his firms have received six first design awards from the American Society of Landscape Architects of which body he is now vice-president.

At the end of seven years of study, first at the Michigan State University and afterwards at Harvard University, where he obtained his masters' degree in landscape architecture, he felt he still lacked a revealing comprehension of purpose. He felt he knew the working technique and terms of his profession, but somehow its indefinable essence had escaped him. Lester Collins, another graduate, who was later to become chairman of Harvard's department of landscape architecture, also shared these feelings, so together they set out in search of the missing truth.

Their pilgrimage took them through Japan, Korea, China, Burma, Bali, India and even up into Tibet. They studied an infinite variety of treatments of wood, stone, metal, plant material, sunlight, shadow and water. They analysed the function and plan of gardens, national forests and parks. They observed people in their movement through space, singly, in small groups and in crowds. They contemplated harbours, palaces and pagodas trying to distil basic planning truth from the inspiring things they saw.

"What counts is the *experience*." This for Simonds is the great discovery he makes. The soul-stirring secret of the Garden of Ryoan-ji was not in its plan or forms or spaces but what was experienced there. The idyllic charm of the Silver Pavilion was sensed without consciousness of planned forms and shapes. The stirring impacts of magnificent Peking came from those places where no plan was evident and no studied form existed. Down through the ages the highest aspects of man's planning are those which bring him into optimum relationship with a force, a concept or an object. The perception of relationship produces an experience. If the relationships are unpleasant, the experience is unpleasant. If the relationships sensed are those of fitness, convenience and order the experience is one of pleasure, and the degree of pleasure is dependent on the degree of fitness, convenience and order.

This is the theme of the book but it starts on such an ethereal and philosophical plane treating with the forms, forces and features of natural and man-made landscape that one begins to doubt its practicability in our mundane world until Simonds goes on to discuss site selection and here both by his sketches and the text he reveals his craftsmanship and experience.

The book goes on to deal with the use of space and volume to give predetermined emotional responses. What appeals to me most is his study of the requirements of the family; his suggestions for inward facing town houses to give the family privacy; the family's links with its neighbours and from that the step by step build up in the social relationship and planning requirements of the neighbourhood, the community, the city and the region all in relationship to landscape architecture.

Not all Simonds has to say is applicable in the United Kingdom. For one thing, we do not enjoy the site option he takes for granted. Nevertheless, his book is fresh, beautifully presented, idea stimulating and will be enjoyed by many.

T. J. HIRST

Waves Under Constraint

Mechanical Waveguides. By MARTIN REDWOOD. *Pergamon Press.* (50*s*)

The concept of a stress wave is commonly introduced to the student engineer by a discussion of the behaviour of a uniform bar when it is struck axially on one end. It can be shown, by quite elementary methods, that the compresssive stress generated by the blow is propagated along the bar at a speed which depends upon the density and the elastic modulus of the material. This treatment is useful because, as well as indicating the basic mechanism of a stress wave, it also serves to explain the process of reflection at free and fixed ends. It is, however, a treatment of limited validity and this can be seen if it is supposed that the initial blow lasts for a very short time so that the stress wave will have advanced only a short distance during the whole of the interval in which the stress increases.

If this is so then the stress wave should form a plane wave front moving along the bar. Now when any section of the bar is compressed axially there will be an outward radial movement of particles in that section because of the Poisson's ratio effect; this outward movement, when it is produced suddenly by a stress wave, will be resisted by inertia forces and the effect of these will be to reduce the axial strain which the bar suffers from a given stress. This effect will be greater at the centre of the bar, where the material is surrounded by the mass of the outer layer, than at the outside; consequently the material will be, effectively, stiffer on the axis than further out. This results in a stress wave being propagated more rapidly along the axis and from this it follows that a plane wave front, as envisaged above, loses its form as it is propagated. It may, in fact, be shown that the simple theory of stress propagation in a bar is valid only if the stress wave is long compared with the diameter of the bar. When this is so the wave takes longer to pass a section of the bar and the radial accelerations at that section are correspondingly less. The validity of the theory may be compared with that of simple bending theory; this also is only valid if the various Fourier components of the curve into which the bar is bent have wavelengths which are long compared with the depth of the bar.

The engineer needs, when attacking these and many other problems, the two-edged sword of the Strength of Materials and the Theory of Elasticity. The former provides solutions whose physical meaning is clear but whose validity may be suspect, whereas those given by the latter often need long and careful examination if their physical implications are to be grasped but are always known to rest on a rigorous mathematical base. It is by intelligent use of both methods in combination that progress is made.

The Strength of Materials approach provides the simple concept of a longitudinal stress wave; it also provides the very similar concept of the propagation of a torsional pulse along a uniform circular bar, the velocity of such a pulse being dependent on the shear modulus. The two types of stress wave are independent of one another and can co-exist. The Theory of Elasticity likewise predicts the possibility of two types of stress propagation through a homogeneous solid, the dilatational wave, of which the longitudinal wave in a rod is an example, and the shear wave exemplified by the torsional pulse. It predicts, however, more than a generalized version of the two types for it shows also that these are the only types of travelling disturbance; from this it follows that when forces, varying in time, act on the boundaries of a homogeneous solid of any shape then the stresses within it can be explained entirely in terms of the two types of stress wave.

Although a stress wave analysis of such a problem is always theoretically possible it is only of practical use when the time intervals associated with the load changes—for instance,

the duration of impulses or the period of sinusoidal variations—is comparable with, or much less than, the time taken for stress waves to traverse the body in question. This restriction on the utility of stress wave analysis resulted until recently in its being used for a few types of problem only: it was extensively studied by seismologists who were concerned with a problem in which the time intervals were moderate but the body to which the forces were applied was very large, was of interest in certain problems concerning the action of explosives where the time intervals were very short, and finally was used in a few isolated engineering problems where bodies of exceptional length were involved; these included pile driving and the stressing of well drill shafts, mine cage cables and railway signal operating wires.

Today there is more interest in stress wave analysis because of the growth of techniques for producing stresses which vary at frequencies up to the radio level, and it is with the problems which are associated with these techniques that Dr. Redwood is primarily concerned. He deals with the basic Theory of Elasticity theorems at sufficient length to give to the reader not previously acquainted with them a moderate background of knowledge. He then proceeds to use this theory on a number of idealized problems where stress waves are reflected from the boundaries of the body in which they move. Such reflections occur in all major stress wave problems for when the waves move through an unbounded solid they continue unchanged—except for slight attenuation due to imperfect elasticity—and no analysis is required. There are many practical cases where the waves are successively reflected between one face and another and it is these problems which give point to the title of the book. It is a book about the behaviour of a system of stress waves which is confined by the boundaries of a body. It treats of waves both in fluids and solids and of both continuous sinusoidal waves and isolated pulses. Approximate methods of analysis are described and some results of experimental work are given. There are extensive references for each chapter.

The book forms a convenient account of the present knowledge of stress waves. As such it will be useful to the engineer who is using them in research or developing apparatus in whose functioning they play a part. The student, new to the subject, should find the book readable but will probably need to supplement it with wider reading both in the fields of elasticity and vibration theory. The book is so laid out that reference is easy both through the index and through the chapter arrangement and subdivision.

D. C. JOHNSON

Analysing Combustion

Gas Sampling and Chemical Analysis in Combustion Processes. By G. TINÉ. *Published for the Advisory Group for Aeronautical Research and Development, North Atlantic Treaty Organization by Pergamon Press.* (42*s*)

Unqualified thanks are due to Prof. Ing. Tiné for his work in assembling the subject matter of this book. Almost apologetically, the preface refers to the seeming narrowness of the topic, but indeed this is only apparent. We have only to consider the appalling misuse of the results of what is often called gas-sampling and analysis, on the one hand, and the hesitancy in using the technique at all, on the other, to appreciate the need for works of this kind particularly in the industrial field.

The book results from discussions held in some thirty research laboratories in the United States of America, France, Germany and Great Britain and is certainly founded on improvements in the techniques of gas-sampling and analysis which have been made necessary by the rapid growth of combustion power plants (turbo-jets, ram-jets, rockets, etc.). In this context, the ability to cast an accurate heat-balance is an urgent necessity for any observations on the efficiency of such devices. In the realm of furnaces and boilers, perhaps, other components are relatively greater (wall losses, refractory storage losses and the like) but nevertheless the exhaust gas loss is high enough to warrant care in its assessment, and to assure the value of this text, even as " extra reading " for many engineers besides those in the more specific field for whom it was written.

Concerning sampling procedures, an exhaustive study is presented of the effects of departures from homogeneity, and homotropy, and the types of probe necessary to minimize the effects of non-ideal conditions of sampling. The significance of iso-kinetic sampling is illustrated, following the conclusion that in heterogeneous streams, this is the only procedure which is likely to give representative samples. Positioning of the sampling probe, the effects of quenching on the chemical composition of a sample, catalytic effects of probe walls, and storage of samples are amongst the properties of systems which affect the validity of sampling; all are well discussed. The geometrical design of the probes themselves forms a review in itself, and this is followed by several recommendations for further study.

One page, displaying a synopsis of methods of gas analysis in the form of a table gives a good summary of the principal methods, and the final section of the book examines these for all the principal constituents in turn. Some engineers will wish to supplement this section by adding Volume II of *Instrument Technology* by E. B. Jones (Butterworth) which presents the instruments themselves in more detail.

To conclude, this is a stimulating review of a subject of the widest possible significance in combustion engineering and one hopes for a correspondingly wide circulation. One further acknowledgement is worth recording: that of the part played by Mr. B. Toone in translating the original manuscript into a script that reads as if it had been written in English.

KENNETH F. BRAY

Trade Publications

Copies of any of the following trade publications are obtainable from the addresses given, though distribution is sometimes restricted.

Miscellaneous

Agricultural and Horticultural Equipment. SIMPLEX DAIRY EQUIPMENT CO. LTD., Sawston, Cambridge. A series of leaflets and folders dealing with equipment for electrically sterilizing soil, soil warming cables, glasshouse heating, plant irradiation, electrical seed propagation, potato chitting, electronic mist propagation, and an adjustable log trestle. Illustrated.

Semi-Trailers. SCAMMELL LORRIES LTD., Watford, Herts. A folder No. 120 and a leaflet No. 121 dealing respectively with the Fourtrak fifth wheel coupling semi-trailer of 15 tons capacity, and the non-reactive bogie semi-trailer. Illustrated.

Sewage Purification. AMES CROSTA MILLS AND CO. LTD., Moss Iron Works, Heywood, Lancs. A book, publication No. 81, on the Simplex high intensity aeration process. Contains detailed technical information and basic design data. 84 pp., illustrated.

Stairtreads. FERODO LTD., Chapel-en-le-Frith, Stockport, Lancs. A folder giving particulars and full-sized illustrations of aluminium channels with brown fabric or coloured moulded filling. Directions for fixing are included.

Filter Media. STILLITE PRODUCTS LTD., 15 Whitehall, London SW1. A brochure giving technical data on filter media. This media, based on fine mineral fibre, is employed in filtration of particles down to 0·1 micron. 8 pp., illustrated.

Electricity on the Farm. BRITISH ELECTRICAL DEVELOPMENT ASSOCIATION, 2 Savoy Hill, London WC2. A leaflet referring to the many ways in which electricity can assist the farmer in dealing with livestock and crops. 10 pp., ill.

New Books

The Meaning of Engineering. By WILLIAM T. O'DEA. *Museum Press.* (21*s*)

Aiming at several levels of readership, the author, who is Keeper in the Science Museum, tries to achieve three objects simultaneously: to provide the student with background and give a depth of purpose to his studies; to increase the insight of the engineering specialist into the scope of engineering as a whole; and to explain to the informed general reader the the engineer's world and his approach to his problems.

Information Theory. Edited by COLIN CHERRY. *Butterworths.* (95*s*)

Proceedings of the Fourth London Symposium on Information Theory, 29 August to 2 September, 1960. Thirty-six papers were delivered in six sessions: Coding and detection theory and statistical theory; Telecommunication systems; Human reaction to information; Sensory information and biological models; Learning machines and other artefacts; Classification theory, synthetics and semantics.

Sequential Decoding. By JOHN M. WOZENCRAFT and BARNEY REIFFEN. *Published jointly by Massachusetts Institute of Technology Press and Wiley, New York and London.* (30*s*)

Probabilistic coding and decoding theory is treated with respect to the binary symmetric channel. Its extension to more general channels is briefly discussed. Readership: communication systems engineers, data processing engineers and information theorists.

An Introduction to Magneto-Fluid Mechanics. By V. C. A. FERRARO and C. PLUMPTON. *Oxford University Press.* (25*s*)

Writing for electrical engineers and physicists, the authors have placed emphasis on basic principles and the more general results so far obtained. The material is presented in two parts: magnetohydrodynamics and plasma dynamics. The annotated bibliography cites some of the more salient papers and books on the subject.

The Reviewers

Mr. S. Death, A.M.I.Mech.E., A.M.I.Prod.E., is senior lecturer responsible for production engineering subjects at the Croydon Technical College. He is also a Member of the Engineering Metrology Association.

Mr. A. A. Smith, B.Sc., A.I.M., A.Inst.W., is with the British Welding Research Association and is head of the welding processes section.

Mr. T. J. Hirst A.R.I.B.A., A.M.T.P.I., A.A.Dip., S.P.Dip., is head of the team of architects with the Laing Development Company Limited. This team has been responsible for the initiation of such schemes as the Smithfield Shopping Centre, Shrewsbury; the Bull Ring, Birmingham, and the City Centre, Blackburn.

Professor D. C. Johnson, M.A., M.I.Mech.E., is professor of Mechanical Engineering at University of Leeds and professor-elect of Mechanics, University of Cambridge. Past experience includes 9 years with Rolls-Royce, where he was development engineer, and he is joint author of the book *The Mechanics of Vibration.*

Mr. Kenneth F. Bray, B.Sc.(Chemistry), B.Sc.Tech. (Fuel Technology), is manager of research and development at Gibbons Brothers, Dudley. A past chairman of the Midland Section of the Institute of Fuel, he is a Member of the Iron and Steel Institute and an Associate Member of the Institution of Chemical Engineers.

Marketing

Selling in Germany

Continuing their series of discussions on the various problems associated with marketing in European countries, SALES AUDITS LIMITED invited four eminent German speakers to address some 50 British industrialists at the Connaught Rooms on 27 October.

Of the salient points emerging, all agreed that the market is wide open and the German buyer has more money to spend than ever before. The demands for success, as far as prospective exporters are concerned, are up-to-date designs of good quality promoted at competitive prices by a lively campaign and, most important, backed up by comprehensive service facilities. It should be recalled that when Volkswagen tackled the British market, vast stocks of spares were established in fully equipped garages before a single car was sold. So much depends on the impressions of early buyers.

The standard of living has improved considerably in Germany during the last decade. The average weekly wage is now 133 DM as against 68 DM in 1950, and the number of cars on the roads has increased sevenfold in the same time. British sales to Germany are running at a level of £170 million a year and Dr. P. von Schweitzer said that careful study of domestic requirements and a vigorous sales effort could increase this figure drastically.

Dr. Rasner, a commercial lawyer, urged British companies to form subsidiaries in Germany, pointing out that it was easier there than in many other countries as German law permits directorship, shareholding and management to be held by foreign nationals.

H. Alexis Joseph, a marketing consultant, emphasized the pitfalls and complications surrounding the British unitary system which although easily understood in the home market, baffled foreign buyers and gave rise to some prejudice. He also said there was a widespread feeling that British goods lagged behind in design, and business methods were too conservative. The Americans were fully aware of this and their efforts to capture sections of the market were meeting with some measure of success.

H. Gerhard Schulz, senior executive of a leading advertising agency, called for an improvement in understanding between the two countries concerning advertising practice and media. He did not feel that a German translation of home advertising was sufficient and suggested that advertising, packaging and promotion be prepared by Germans who thoroughly understood indigenous demands.

H. Hans Jaeger perhaps provided the keynote and drew general agreement when he stipulated thorough market examination and a campaign mounted with the same care and forethought as for the home market. Germany, he said, should be treated as a separate domestic market which demands the full marketing treatment.

Logistic Ship Order for the Clyde

A tender submitted by the FAIRFIELD SHIPBUILDING and ENGINEERING COMPANY LIMITED for a 6,000 ton logistic ship has been accepted by the Ministry of Transport.

Designed by the Ministry to meet the requirements of the War Office for a fast troop carrier capable of discharging over a beach, the new vessel may be the first of many which will eventually replace the existing LST's (landing ships-tank).

The final cost of the ship, which will be 415 ft long, will be in the region of £1¼ million. Improved existing features of the LST design will be incorporated and it is expected that there will be accommodation for a representative cross-section of all vehicles currently in use with the Army or likely to be introduced in the near future. Special features include bow and stern loading facilities for tanks and military vehicles ramp hatches, cargo handling by cranes instead of conventional derricks and provision for carrying and launching pontoons. A special deck will be provided for a helicopter which will aid loading and discharging.

With a speed of 17 knots from its diesel engines the vessel's role in time of war would be as a follow-up to an amphibious or airborne operation. In peacetime it would be used for moving men, vehicles and equipment from one command to another. Passenger comfort and recreational facilities will be of a high standard.

Completion is scheduled to be within two years.

VLF Station for NATO

REDIFON LIMITED, a subsidiary company of Rediffusion Limited, are to collaborate with ELECTRONICS CONTINENTAL Inc. of Dallas, Texas, in building a VLF transmitter for NATO. To be installed at Anthorn near Carlisle, Cumberland, the equipment will be capable of transmitting 100 kW at 20 kc/s and the contract, placed by the Post Office Contracts Department of the GPO, is valued at £3·8 million.

Consulting engineers on the project are Brian Colquhoun and Partners.

British Industry Analysed and Tabulated

ROBB HOLLAND LIMITED, who deal in direct mail advertising, have recently published a most informative booklet called "British Industry Defined for Direct Mail Advertising."

In its 31 pages it sets out to divide a calculated 38,875 manufacturers employing 10 or more people into 12 categories: engineering and metal; food, drink and tobacco; textiles and wood, to give a few examples. In a glossary at the back a list is given of the commodities covered by each division and it appears that everything from oil refining plant to vacuum flasks is covered.

Further lists divide the country into marketing areas and the companies mentioned into five grades depending on the number of employees and factory floor space. This information is then tabulated on a separate page for each industry so that at a glance, interested parties may ascertain the size and distribution of the firms engaged in each particular industry in the separate marketing areas.

Such a publication besides providing information for those planning mail advertising also comprises a useful directory which should prove helpful to industry in general.

Robb Holland have recently moved to a new premises at 86-88, Acre Lane, SW2.

Industrial Diamond Sales Up

There has been a marked increase in the sale of industrial diamonds in Europe over the last three years. The 1960 sales figures of boart, indispensable in industry for machining hard materials, show an increase of 150 per cent over those for 1958.

Figures released by the Central Selling Organisation for the past three years are:

1958	.. ..	1,766,668 carats
1959	.. ..	2,233,231 carats
1960	.. ..	4,441,669 carats

European sales for the first nine months of 1961 show a further increase.

With constantly rising wages, European industry is cutting production costs by using diamonds in a widening range of processes and consumption is rapidly overtaking that of the US.

Further CEGB Contract for Mitchell

MITCHELL CONSTRUCTION COMPANY LIMITED have been awarded a further contract by the Midland Project Group of the Central Electricity Generating Board.

Worth about £275,000, the contract covers the construction of a workshop and office block together with ancillary installations for the Drakelow 'C' power station at Burton-on-Trent.

Work commences almost immediately and on completion, which is scheduled for December, 1963, the value of work carried out by the company at Drakelow will be approaching £1½ million.

The consulting engineers on the project are L. G. Mouchel and Partners.

Power Generation in Hong Kong Increased

The output of the Hok-Un power station in Kowloon, Hong Kong, is to be increased. The station, which is owned and operated by a British concern, China Light and Power Company, at present employs eight turbo-generators of AEI manufacture giving a total out of 182·5 MW.

This will now be almost doubled with the addition of two 60 MW sets, the order for which has also been placed with AEI. Included are condensing plant, de-aerator and auxiliaries. Installation of the first plant is now nearing completion and erection of the second has started.

Steam conditions are 915 lb per sq. in and 900° F and the air-cooled, direct coupled generator will have a capacity of 11·8 kV at 3-phase 50 cycles per sec when running at 3,000 rpm.

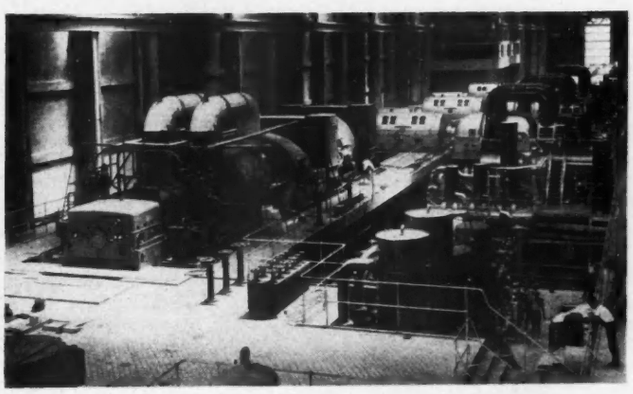
Machine Tools: Age and Coming of Age

Mr. J. R. T. Gibson Jarvie, deputy chairman, United Dominions Trust, and chairman of the Finance Houses Association, spoke of machine tool replacement at a luncheon following the 21st annual general meeting of the British Association of Machine Tool Merchants in London recently.

He said that while machine tools might be old in the case of a company with which he was connected they could still make nice profits. Replacements of such tools might be too slow, but this could be due to finance not being forthcoming. Fixed period finance was unsuited to the purchase of machine tools and long-term facilities were now available. It was no use telling the Government that things were difficult—they would continue to be and one must face up to it. The Government would listen if business were done.

The president, Mr. C. Oldfield, referred to entry into the Common Market. In 1950 deliveries of machine tools to British industry totalled £40,000,000. Tools to the value of £16,750,000 were exported and imports were valued at £5,750,000. In 1960 total British deliveries were worth £95,000,000, exports were valued at £29,000,000, and imports at £23,750,000. These imports were mainly from European ceuntries, who without any Common Market assistance had increased their sales here from approximately an eighth of the total to about a quarter in the period concerned.

The Rt. Hon. Lord Mills, Minister without Portfolio, said that the association fulfilled an important function in giving technical assistance to the country. He congratulated them on attaining their 21st birthday.



The Hok-Un power station in Hong Kong, showing the eight existing generators and the first of the new 60 MW sets under construction

The Aldis 303 Home Slide Projector

In the consumer market no loss of time can be afforded in keeping up with public demand, particularly where that demand is continually changing.

THE Aldis 303 slide projector appeals to the colour conscious—by displaying on a screen vivid lifelike pictures taken by one's own camera.

It is not hard to see why the slide projector is a comparatively recent addition to the British home scene. In 1950 colour films were costly and fussy as to light conditions. To obtain good results meant investing in expensive camera equipment, and taking considerable pains to use it correctly. Colour photography was, in fact, a rich man's hobby, not to be taken too seriously by the less wealthy amateur.

During the intervening years the picture has completely changed. Improved techniques in film manufacture, coupled with an increasing demand, steadily reduced the cost until it suddenly brought the colour film to the stage of general public acceptance. Less expensive cameras could now take colour films and even an inexperienced user could get good results. The colour slide was beginning to take the place of the familiar black-and-white snapshot mounted in an album.

Herein lies the biggest limitation of colour work—the inadequacy of the printing process in terms of both cost and the faithfulness of the result. True, printing has greatly improved since the early days of colour, but there is still no immediate prospect of effective colour printing being performed for the same cost as black-and-white; a cost that is itself continually rising rather more rapidly than the inexorable increase in the cost of living.

Fig. 2 One of the earlier home projectors, the Aldisette II.

So the door was suddenly opened for quantity production of special equipment for displaying colour transparencies, rendering enlargement and printing unnecessary. The two instruments that suggested themselves were the simple pocket viewer and the home projector. Aldis Brothers Limited, probably better known by reason of the famous Aldis signalling lamp, were one of the companies determined to take advantage of the new situation, and they lost no time in adding both kinds of display equipment to their range. Now the slide projector is becoming a mark of social status, as it already has done in the USA, Germany and Japan.

SPEED ESSENTIAL

In any exercise of this kind, speed of action is most essential. Aldis Brothers happened to be in a favourable position by virtue of having started manufacturing projection equipment in a small way with the lecture hall type of instrument before the Second World War. The increasing importance of visual teaching aids coupled with successful design led to a steady expansion after the war, which won the company a firm place in the projector market.

Their first purely domestic projector, the Aldisette, was introduced in 1955, being merely a smaller form of the lecture hall " magic lantern." By contrast, the 303, introduced in 1958, was a complete breakaway from the traditional form —an important milestone in domestic projectry. Despite gloomy forebodings on the part of their distributors, the success of the 303 exceeded all expectations in its first few months, and today it represents no less than 66 per cent of Aldis's total projector sales.

The astonishing changes in the company's projector activities over the past eleven years are indicated by the following rough statistics. In 1950 they were supplying one home projector for every nine supplied to industrial and educational establishments. The trend during the intervening years has seen a complete reversal of the situation. Thanks to the ever-increasing use of visual aid for teaching purposes, the number of projectors for education has risen, and total projector output has multiplied about seventeen times. Yet, due to improved factory methods and organization the total number of employees has no more than doubled.

Not surprisingly, the rapid growth in popularity of colour transparencies has attracted many firms into the field. Now there are no less than 130 different slide and film strip projectors on the market in this country (including imported models) of which only ten are of Aldis manufacture. The 303 cannot hope to get things all its own way under such competitive conditions—but it is probably the best seller in this country today.

INSTANT RESPONSE

Its popularity stems from a shrewd company policy of instant response to every change in the market. Where ruthlessly scrapping traditional principles to make way for bold original ones has been considered desirable, it has been carried through—without delay.

This policy is nowhere more evident than in the 303's construction. Its intricate but satisfying aluminium pressure die-castings are a sign that steel pressings screwed and spot welded together have started to go by the board in projectors since, for the first time, castings are used for all the major components of this machine, affording a big saving in assembly operations. A product intended for a mass consumer market must use mass production methods in order to be economically feasible.

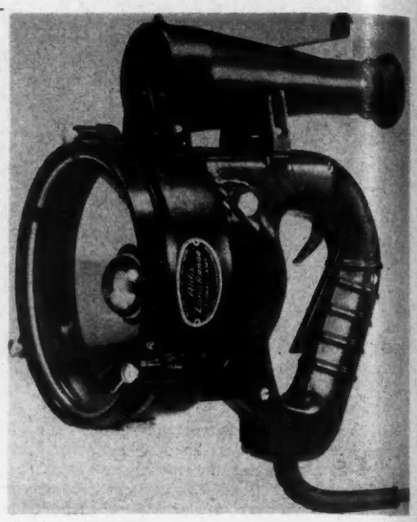


Fig. 1 The famous Aldis signalling lamp established during the First World War.

The basic requirements for a successful domestic projector may be summarized:

(1) An adequate optical system.
(2) Cooling of the lamp, slide carrier and body.
(3) Reasonable portability.
(4) Low retail price.
(5) A well designed exterior.

To these five, in the 303, were added:

(1) Low styling, a clearly discernible trend in domestic and other equipment, which also serves to improve portability.
(2) Provision for semi-automatic slide changing.
(3) Improved cooling to suit lamps of higher wattage.
(4) Up-to-date measures for quantity production.

They reflect an immediate awareness of the public's new, if partly subconscious, requirements.

Perhaps the most radical change in company's outlook took place at the " crossover point " in the mid-1950's when the number of projectors supplied for the home began for the first time to outstrip those for education. Aldis Brothers' reaction was immediate—they brought out the Aldisette range, specifically intended for domestic use.

STREAMLINE DESIGN

Apart from size, however, there was little outward difference between the lecture hall and the living room models at that time. All projectors were tall and ungainly, resembling a gun turret with a protruding muzzle. But there was a big difference in the optical system. A domestic projector is expected to display a proportionately much larger picture on the screen than the school machine, in relation to its distance from it, and it uses a lamp of lower power. The 303 for example can project a picture 5 ft square at a distance of 12 ft from the lens when using the standard three-element f 2·5 anastigmat lens of 8·5 cm focal length. By contrast, Aldis's largest lecture hall projector, the " Star " 1000 with a 1,000 watt lamp, takes a lens of 30 cm focal length. It can project a picture 11 ft wide at a distance of 100 ft from the same 35 mm transparency in a 2 in square mount. The " Super Six " and 1000 models are produced primarily for use with the 2¼ in square slides.

The wide variation in performance between extreme ends of the scale, coupled with a growing demand for fully automatic slide changing, explains why Aldis are currently offering ten

Fig. 3 Another product where drastic restyling and mass produced pressure die-castings go hand-in-hand.

slide projectors in order to provide a complete market spread, without interaction. Variations within the range are facilitated by a policy of lens interchangeability. An epidiascope (called the Epivisor) and a slide viewer complete the range.

The fresh approach to projector design evinced in the 303, and in the more powerful 505 introduced at the same time, renders direct comparison with earlier models difficult; but machining operations, for example, are some 30 per cent less. Aluminium pressure die-castings form the chassis, body and detachable lid.

The chassis is the most intricate casting; it incorporates the lens housing and, apart from the saving in assembly work afforded by a casting, it offers better rigidity so vital to the effectiveness of the optical system. Each of the four saddles rising from the base of the casting carries a cast-in location for one of the optical components as shown in Fig. 5. Final alignment with the lens is provided by removing the slight taper from the lens housing, which is bored true off the condenser seatings. The lamp seating, which incorporates adjustment for lamp height, is mounted beneath a raised platform cast in front of the reflector saddle.

NO LIGHT ESCAPES

The cooling arrangement differs from previous projectors in that instead of a blower fan mounted beneath the lamp the 303 has a large extraction fan placed at the side. This arrangement provides an effective flow of cool air over the lamp, drawn from the underside, and eliminates local air hot pockets which a blower tends to create. Stray light leakage on the fan side is practically eliminated by careful arrangement of the louvring in the body casting. A shallow register around three sides of the lid serves a similar purpose.

All production is carried out at the Birmingham factory under excellent working conditions. The premises were recently extended by the addition of a contemporary-styled three-floor block, the top floor of which is devoted to lens manufacture. In keeping with company policy

Fig. 4 The fully automatic projector, the XT360, one of the current range of models.

this work is highly mechanized, most of the equipment, including all the lens polishing machinery, having been made in their own toolroom.

Glass is first cut from slab, and moulding to approximate shape takes place in one of five ovens. After grinding, polishing and edging, the lenses are " bloomed " by the deposition of evaporated magnesium fluoride under vacuum. Blooming gives the glass a hard, scratch-resisting surface and also reduces light loss due to internal reflection.

The machine shop and press room are in the older part of the factory. Continual changes are being made to the machinery in order to step up production and lower costs, principally by reducing the number of separate operations. To overcome earlier supply difficulties all motors are now built up on the premises, and final projector assembly is carried out on the conveyor belt principle. Each projector has fan, projection and conductivity checks before dispatch.

OPTICAL BACKGROUND

Aldis Brothers have a successful history of optical equipment manufacture going back to 1902, when the two brothers, A. C. W. Aldis and H. L. Aldis, began making anastigmatic lenses in a converted stable at Sparkhill, near Birmingham. The famous signalling lamp became established during the First World War, and it was being exported in quantity soon afterwards. The excellent reputation of the Aldis lamp, still a best-seller today due to continual improvement, coupled with the firm's strong export-consciousness, have given the company a strong position in overseas markets, with a world-wide network of agents. This situation has proved invaluable on the export of projectors, some 25 to 30 per cent of which find their way overseas. Despite tariff restrictions and stiff competition their projectors are meeting with some success on the Continent, and so important are the European trends considered in relation to the company's products that a senior sales executive is resident in Germany, centre of the optical industry. The timely feedback of information through travelling representatives, agents and distributors is germane to the company's wide-awake attitude to their market.

MARKET AND RESEARCH

What difficulties face a company like Aldis Brothers operating in the consumer market? They have to be careful not to have a range that is too large and unwieldy; they must select and concentrate on the items that are best suited to the market.

Secondly, how can the research and development resources be utilized most effectively? The answer to this question lies in separation of product design (in this case including the services of an industrial designer) from the development of production tooling. Such a division is shortly to be undertaken by Aldis. Considering the close liaison they maintain with their marketing organization, this step underlines the possibility of more radically new projector concepts emerging from the Aldis factory in the not-too-distant future.

Aldis Brothers Limited, Priory Works, Sarehole Road, Birmingham 28; a member of the Pullin Group Limited, Brentford, Middlesex.

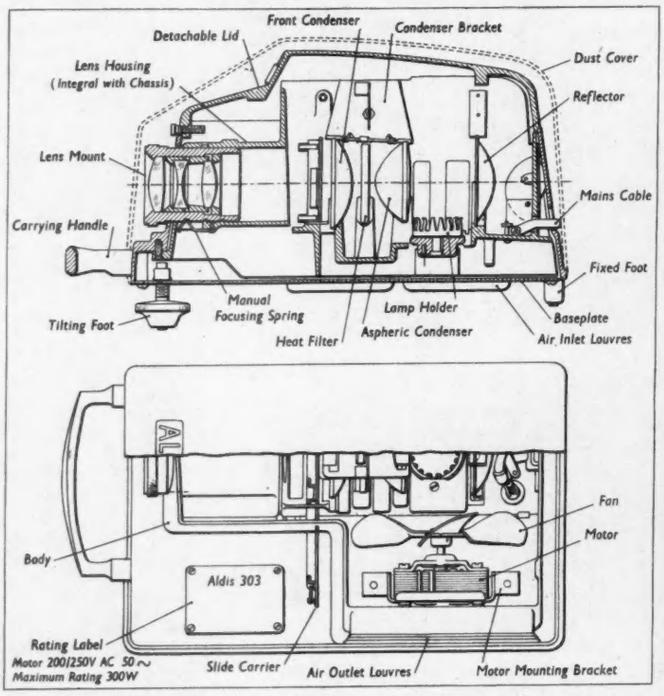


Fig. 5 (above) Drawing showing the internal arrangement of the standard 303 model. The cast saddles can be clearly seen.

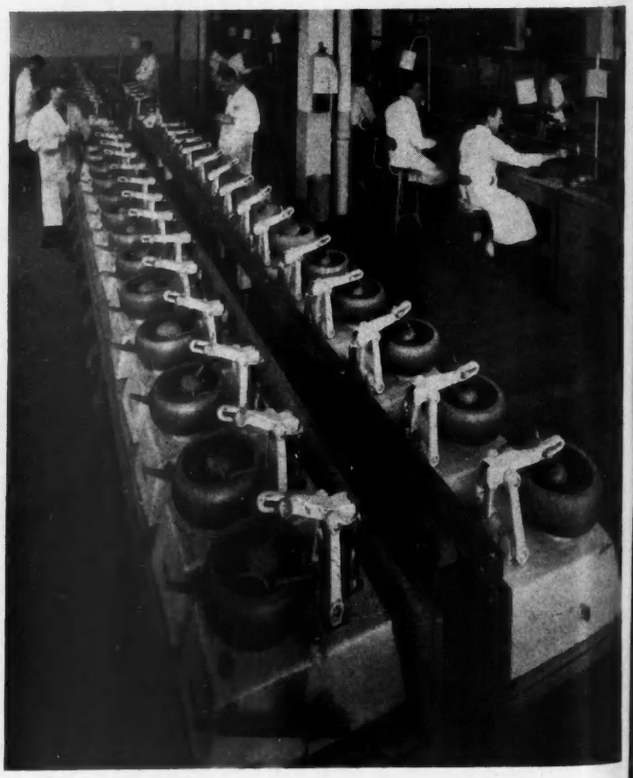


Fig. 6 (right) Polishing the deep sides of the lenses, using machines of company's manufacture.

Development of a Man-Powered Aircraft

Brief, low altitude flights have recently been made with a man-powered aircraft. The development of this aircraft has largely been an exercise in establishing optimum aerodynamic and constructional design criteria.

By M. V. Lowson, B.Sc.(Eng.)

TABLE I.—*Summary of Characteristics*

Construction and stressing	*Performance and aerodynamic data*
Wing: 2 spar spruce and ply, girder ribs, nylon cover. Fuselage: Spruce longerons and diagonal bracing nylon cover. Central fuselage frame: Aluminium tube and plate, welded and riveted; flexible shaft for final 90° drive. Propeller: Built up over aluminium main spar.	NACA 65/3,818 wing section NACA 65,018 tail plane NACA 65,009 fin C_{m_0} = 0·12, Aerodynamic centre = 0·275 chord C_D = 0·575, based on wing area C_L = 0·85, C_L max = 1·3, Mean Rc = 7.10⁵ Aspect ratio = 21·3 Wind loading = 0·90 lb per sq ft. Time to climb to 15 ft from rest ≏ 30 sec Design max. power output = 0·55 hp Design cruise power output = 0·45 hp Design propeller efficiency = 90 per cent at 260 rpm Actual propeller efficiency = 85 per cent at 260 rpm Design drive efficiency = 97 per cent Power to cruise at 15 ft = 0·337 hp Pedal rate for propeller at 260 rpm = 90 rpm
Maximum positive load factor = 1·5 Maximum negative load factor = 1·0 } flight case Maximum gust load factor = 1·5, wing stalled	
Stability and control Static margin: stick fixed + 0·0375 $\bar{C}$ stick free + 0·0375 $\bar{C}$	

CURRENTLY undergoing trials, and much in the news, is the man-powered aircraft designed by graduates of Southampton University. This was done in response to the challenge of a prize of £5,000 offered in November 1959 by Mr. Henry Kremer for a successful controlled flight by such a machine.

Man-powered flight has been achieved before, by the German Haessler-Villinger machine in 1935-6 and the Italian Bossi-Bonomi aircraft in 1936-7. The Haessler-Villinger machine flew about 700 yards in a straight line, and the Bossi-Bonomi over 1,000 yards in a more or less rectangular course. Most of these flights were initiated by a catapult launch and the pilot merely had to sustain the machine in the air. However, Bossi has stated that, at a press demonstration, his pilot achieved the hitherto unique feature of taking-off under his own power without storage of energy.

The rules of the Kremer competition state that the aircraft must take off under the muscle power of the crew, without any storage of energy, fly a figure-of-eight course around two posts half a mile apart and be at least 10 ft above the ground at start and finish. This is a very difficult task, and it is almost certain that neither of the two pre-war machines could have accomplished it. However, those who are now working in the field have a further 25 years of aircraft design experience available to them, and now it is generally thought that such a flight is quite possible.

The Power Problem

The first aspect of the design to be considered is the actual power a man is able to produce. It is common experience that man is able to produce more power over short periods of time than during exercises of longer duration, but the lack of reliable data about the power output of man was quite remarkable. The recent renewal of interest in man-powered flight has inspired several investigations, and results summarizing the power output of champion athletes are presented in Fig. 1, taken from a paper by D. R. Wilkie.[1] It is interesting to realize that muscle is actually a form of "fuel cell," since the chemical energy is transformed into mechanical energy without appearing at an intermediate stage as heat.

This energy can be developed from two sources. For long periods the power is limited by the amount of oxygen that can be absorbed at the lungs, but over shorter periods (two to five minutes) the body can utilize a certain extra amount of energy stored in the muscles, the so-called "oxygen debt."

It is found that the maximum amount of oxygen that can be absorbed at the lungs can all be used by the legs alone, thus, although the use of other muscles could increase the short period power output due to the greater utilization of "oxygen debt," the long duration power output can be no greater than about 0·5 hp whatever combination of muscles is used.

A well designed modern glider would require about 4 hp to keep it in straight and level flight, so it can be seen that a considerably refined design is required to enable man-powered flight to be accomplished.

Fortunately, the power required to overcome the profile drag of an aircraft is proportional to the cube of the speed, so that by arranging to fly very slowly—about 15-20 mph—the power is considerably reduced. Unfortunately, the power required to overcome the induced drag, or drag due to lift, is inversely proportional to the speed; so a man-powered aircraft must have a large wing area and a high aspect ratio to overcome the undesirable drag increase at low speeds due to this factor.

The induced drag can also be reduced by as much as half by "ground effect." The aircraft therefore needs to fly as close to the ground as possible, consistent with the pilot's skill and safety, so that the minimum power need be produced.

It is amazing to realize that the Southampton University machine, with a wing span of 80 ft, has a drag at cruise of only 7 lb.

The success of the project is dependent to a large degree on the lightness of the structure. It must be designed to the smallest possible margins of strength, and ideal flight conditions assumed. The aircraft cannot be allowed to operate on gusty days or over unmade runways.

The whole problem has been to make the structure weak enough. The general tendency of the designer to reinforce must be fought at almost all costs. The Italian Bossi-Bonomi machine was designed by Bossi and reinforced during the course of its construction by Bonomi, eventually being 30 per cent over weight. This was probably the main reason for its inability to do more than short hops.

Aircraft Layout

A conventional layout for the aircraft was adopted early in the design. The helicopter and ornithopter machines have their advocates, but the design of such machines would need far more information than is available at present, whereas the aerodynamics of the conventional aircraft are well known.

The general arrangement of the aircraft is shown in Fig. 2. The only unconventional feature is the pusher propeller mounted above and slightly behind the wing on a pylon. In addition to the drive and mounting for the propeller the pylon also contains the pilot's head. A high position for the propeller was chosen in order to minimize the length and therefore the weight of the undercarriage required. The propeller was placed behind the wing in order to maintain a smooth laminar flow over the wing surface.

The high wing layout was chosen to obtain ground clearance, particularly in order to allow the aircraft a certain amount of rolling manoeuvrability during take-off and landing without driving the wings into the ground.

The pilot needs his hands and arms free for controlling the aircraft, and so a cycling method was adopted as the means of power production. The conventional cycling position has the disadvantages of large frontal area and poor forward vision, but by choosing a semi-reclining position so that the cyclist is sitting back at about 15 degrees, both a small frontal area and an excellent field of view are obtained. An important additional advantage of the position is that a back-rest can supply all the required reaction for the legs so that the arms are completely relaxed, even during periods of maximum effort. Tests were made on members of the local

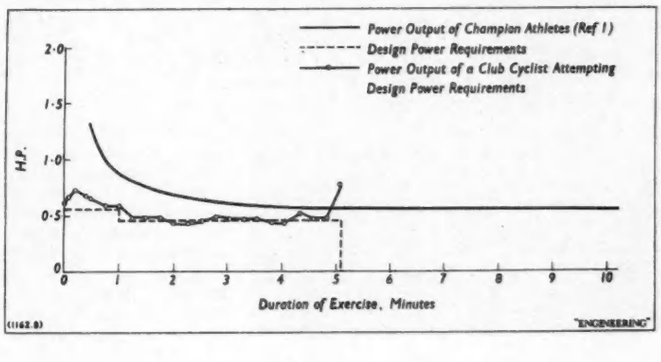


Fig. 1 Graph summarizing the power output produced by various types of athletes.

Research Report

on work at the

Department of Aeronautics and Astronautics, Southampton University

Head of Department
Professor E. J. RICHARDS

Initial Design of the Man-Powered Aircraft
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Additional Work
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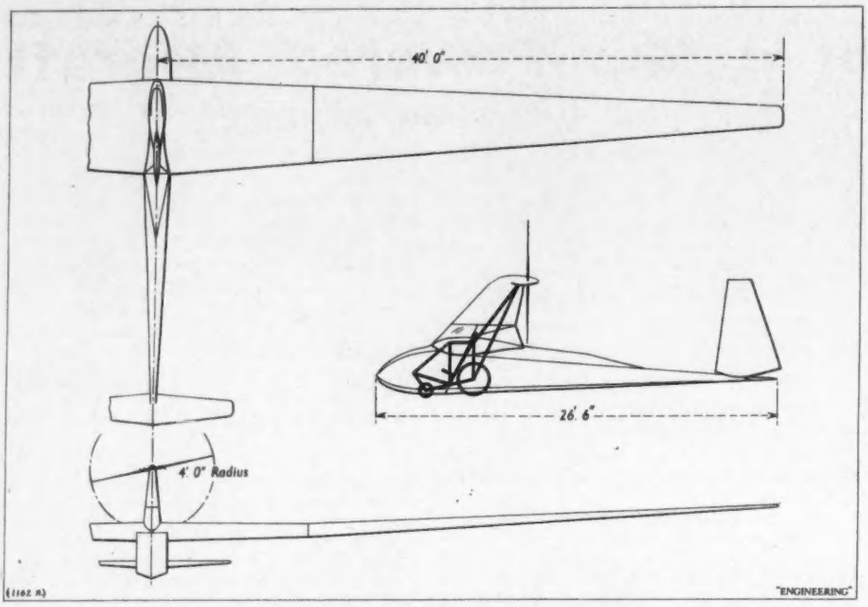

Fig. 2 General arrangement of the Southampton man-powered aircraft. A notable feature is the pusher propeller, mounted on a pylon behind the wing.

cycling club, and other volunteers. These showed that the position was comfortable and that the power required could be produced by a cyclist of average club standard (see Fig. 1).

The drive from the pilot's pedals is by chains to the back wheel and then by belt to the propeller. An interesting aspect of the research on the man-powered aircraft is that upon the efficiencies of power transmission systems at low powers. It has been found that while most belt and chain drives are 98 per cent or more efficient, gears of all types are only 90 per cent efficient. The choice for the man-powered aircraft was therefore obvious, since a belt or chain drive was likely to be simpler and lighter than gearing in any case.

The back wheel provides the drive to the aircraft while it is on the ground, and is geared so that the propeller will take over the thrust production at take-off speed. This was necessary since the propeller is extremely inefficient at low forward speeds, and if the pilot were to rely on the propeller alone he would be extremely tired and probably off the runway before he had developed enough speed to take off. The back wheel also incorporates a free-wheel to avoid an impulsive force on the pilot's legs at touchdown. Standard parts were incorporated in the machine where possible, and the driving wheel, pedals, chain and bearings were all standard racing cycle parts as used on commercial machines.

Construction Details

The major portion of the aircraft was built by the designers themselves in off-duty hours during the evenings and weekends. Very simple constructional and design techniques had to be evolved because of the unskilled nature of the labour available and the inexperience of the designers.

The aircraft is almost entirely constructed from wood, the exception being a central light alloy frame supporting the pilot, drive, undercarriage and propeller (see Fig. 4). It was very tempting to use the new and exotic materials which have recently become available, such as glass fibre, foam plastic and so-on, but it was felt that this would require much more development than a small team would be able to do, and the current constructional techniques used with these materials involved punitive amounts of jigging and skilled labour.

The jigging required on the aircraft had to be kept to a minimum. Most of the details were laid up flat on a table or floor. Extensive use of magnified model aircraft constructional techniques was made.

The wing construction is shown in Fig. 3. The basic load carrying member is a four boom torque box to which the ribs are attached. As the leading-edge shape has to be preserved for aerodynamic reasons, it is sheeted in as far as the front spar with $\frac{1}{16}$ in balsa. The wing and the rest of the aircraft are covered with a nylon parachute fabric, silver doped to protect the fabric from the effects of ultra-violet light.

TABLE II: *Leading Dimensions*

Length	26·5 ft
Height	8 ft
Span	80 ft
Wing area	300 sq. ft
Tailplane	Span 10 ft. Area 15 sq. ft All-moving surface
Fin	Height 6ft. Area 15 sq. ft All-moving surface
Ailerons	Length 20 ft
Pylon	Height 4 ft. Area 10 sq. ft
Propeller	8 ft dia rotating at 260 rpm
Undercarriage	Main, 27in cycle wheel Forward, 8in wheel
Cruising Speed	29·5 fps = 20 mph
Stalling Speed	23 fps = 16 mph
Cruise hp	0·4
Weight, Empty	130 lb

The wing was made in three sections. The centre 20 ft section bolts directly to the central light alloy frame, with the outer 30 ft sections bolted either side in a four point attachment. The wing joint fittings are made out of light alloy and attached to the booms with Araldite. Tests showed that the alloy fixing failed before either the glued joint or the laminated wood.

The wing ribs were made individually (mainly out of $\frac{1}{4} \times \frac{1}{8}$ in spruce) over a drawing, the members being held in place by pins. The spars were also drawn out and constructed in a similar fashion. A design feature of the spars is the multi-laminated construction. In addition to reducing the likelihood of a fault in the booms, this method of construction means that by sandwiching the shear members between the laminations sufficient glue area is obtainable without the necessity for gussets.

An exceptionally simple jigging system was evolved for wing assembly. There is a certain amount of twist built into the wing, which occurs as a series of linear variations. Pieces of hardboard were drawn up to fit at certain reference stations. These had one reference point—a hole; and one reference surface—an attached piece of wood. Stands were fixed to the floor and the hardboard clamped to the stands so that the reference holes were in a line, as ascertained with a piece of taut cotton. The reference surfaces were then set to the required degree of twist with a climometer, and assembly proceeded. The method proved very successful.

The fuselage is in two sections, in front of and behind the central frame. Each section is basically a rectangular tapering box. The four sides were made up individually on the flat and then joined together with a minimum of frames. A type of light alloy fixing, similar to the wing joints, was used to attach the front and rear fuselage to the central frame.

Controls

If a conventional type of layout is used there are unlikely to be serious problems of stability and control. The only difficulty is in transforming the normal foot-operated rudder bar into some type of hand-operated control. It

Fig. 3 (left) The basic load-carrying member of the wing is a four boom torque box, to which ribs are attached.

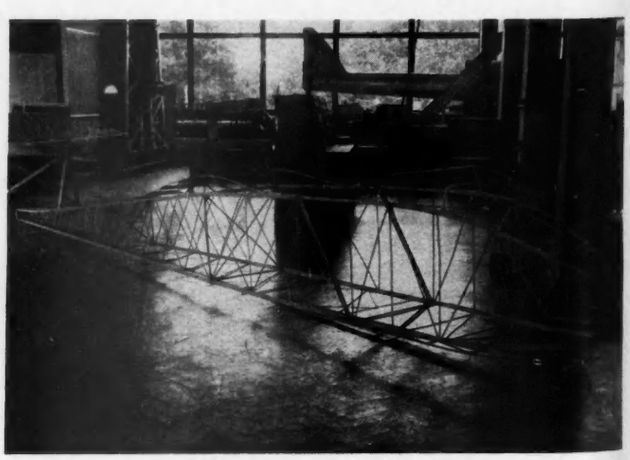

Fig. 4 (right) The aircraft is almost entirely made of wood, with the exception of a central light alloy frame to support the pilot, undercarriage, drive and propeller.

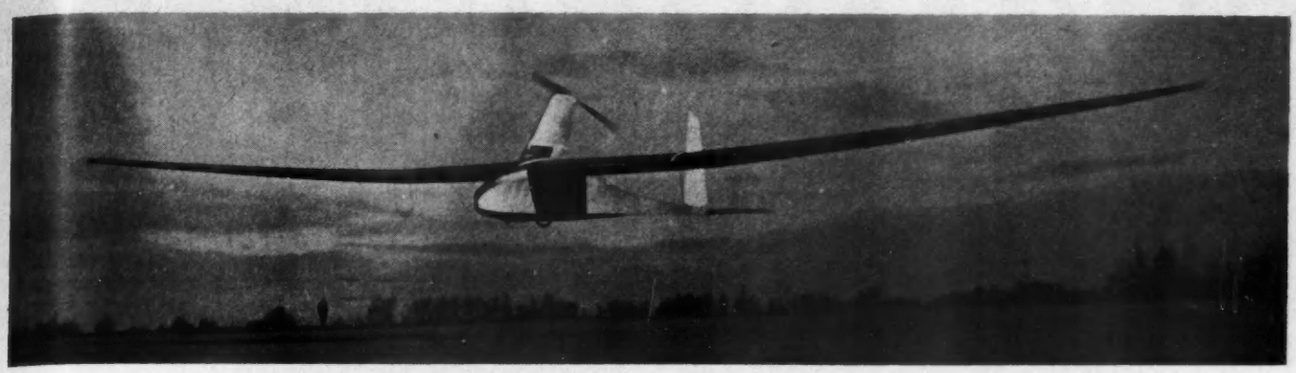

Fig. 5 Although it has a wing span of 80 ft, when cruising the aircraft is subject to a drag of only 7 lb.

has been suggested that this control may either be eliminated or connected in some way to the other controls of the aircraft.

The main purpose of the rudder is to counterbalance the drag moment that arises when the ailerons are operated. Experience with gliders has shown that this moment increases in severity with wing span. A rudder is therefore necessary and in fact this aileron drag moment is so large that some form of compensating device on the ailerons themselves is also necessary. A gear ratio of 2:1 between the up and down ailerons was adopted.

It was thought that a linked rudder system would take too long to develop and the possibilities of failure during the development period while flying so close to the ground could easily lead to disastrous results. Of the six available degrees of freedom for a control only two are used on a conventional aircraft. Thus there is a choice of four for the rudder movement at the hands.

The control selected is a bar inside and parallel to the wing leading edge. The pilot sits grasping the bar with his hands, elbows and shoulders level. The control movements are fore and aft for pitch, side to side for roll and twisting about a vertical axis for yaw. These motions were picked primarily so that the pilot's hand movements would be confined to the small volume available.

Both the fin and tailplane are all-flying surfaces, chosen mainly because of the simplicity of construction. The ailerons are inboard of the wing tips. These were constructed with the wing end finally sawn off and completed. The control wire is a nylon-covered steel shark-fishing wire with a breaking load of 120 lb. The total weight of all the control details apart from the actual control surfaces is 1·5 lb.

Why has sustained man-powered flight not been achieved before? Perhaps the most important single factor is the availability today of much improved synthetic glues which enable much simpler and lighter structures to be designed. Pictures of older wooden aircraft reveal a fantastic array of internal and external bracing wires attached to the primary structure with complicated systems of flanges and turnbuckles. Such a method of construction would be completely out of the question for the man-powered aircraft. Fortunately, today the glue is usually stronger than the wood, so the necessity for such complication is avoided. In fact, five different glues were used for particular applications on the Southampton University man-powered aircraft. Each section of the aircraft is entirely held together by glue.

A second factor is the greater understanding of the basic causes of drag on aircraft, and in particular the range of laminar flow aerofoils developed since the beginning of the war. Naturally the modern aircraft designer is able to benefit from further collective experience in aircraft design and perhaps more particularly from the more scientific attitude to design prevalent throughout the industry today.

Further Improvements

It is already possible to see a number of improvements that could be incorporated in a Mark II aircraft. The basic problem in the design has been to make the structure light enough. Many parts of the structure are considerably overweight because it was not thought practicable to go to smaller members (the smallest structural member is made from $\frac{1}{4} \times \frac{1}{8}$ in balsa). With the experience now gained it should be possible to redesign many of these members and save weight.

Since a major proportion of the wing weight is in the spars, there could be an advantage in using aluminium alloy or reinforced plastic for their construction. This could more than halve the spar weight. These materials were not used on the Southampton machine because of the difficulties of home construction and expense, but for a more sophisticated machine they would seem to be essential.

Recently a basic contribution has been made to aerofoil design by F. X. Wortmann and R. Eppler. The resulting aerofoil has been flight tested on the Phoenix glider[3], and appears to offer considerable advantages to a man-powered aircraft in low drag and high lift.

It is of interest to note that all the design work on the Southampton University man-powered aircraft has been done by newly fledged graduates, with little or no design experience. In particular Alan Lassiere, Anne Marsden and David Williams were responsible for all the initial design work. This must argue against the common practice of regarding all new graduates as worthy of no more than the hewing of technical wood until they have gained " maturity " and " experience," by which time their enthusiasm and ideas may well have vanished irredeemably.

References

[1] D. R. Wilkie. " Man as an Aero Engine " *J.R.Ae.S.*, Aug, 1960.

[3] A. Raspet & D. Gyorgfaloy, " Boundary Layer Studies on the Phoenix Sailplane." *Swiss Aero-Review*, March, 1961.

Reorganization in Welding Research

The British Welding Research Association have announced a number of important changes in their internal administration. These will have the effect of extending the scope of the services provided for industry and, at the same time, of enabling fundamental work, particularly in arc physics, to develop without hindrance.

Under the new arrangement, which came into effect on 1 November this year, the former Welding Process and Resistance Welding sections have been integrated into one Welding Technology Department, with wide terms of reference. These include carrying out such research as is necessary to extend the range of usefulness of existing welding processes for particular applications and to provide basic data for the design of welding plant. The department will be given extended facilities for investigating all new methods of welding and welding technology and they will make available assessments of these for general and specific purposes.

Administration of the new department is the responsibility of Mr. P. T. Houldcroft, formerly the Association's Chief Metallurgist, who now becomes head of the Welding Technology Department. Mr. A. A. Smith, formerly in charge of the welding process section, will be Deputy Head. Complete administrative responsibility for, and control of, the metallurgical laboratory is assumed by Mr. H. F. Tremlett, the Deputy Director of Research, with Dr. R. G. Baker and Mr. J. G. Young as Chief Metallurgists in charge of, respectively, ferrous and non-ferrous research.

Interest in the physics of the electric arc, including the development of techniques for controlling and utilizing ultra-high-temperature arc plasma, and in the development of electronic control and monitoring systems, has now reached the stage where it is necessary to allow these investigations complete freedom to expand if their potential is to be completely exploited. This work will now be entirely under the control of Dr. A. A. Wells, the Assistant Director of Research, who also controls the Association's Engineering Research.

The integration of the resistance and arc welding processes, will bring into line such " fringe " processes as friction and electron beam welding, up to now regarded as self-contained projects, and will enable their use to be considered along with that of the more conventional processes in connection with, for example, the DSIR-aided Prototype Welding Service, which was recently provided for the benefit of member firms. The particular advantage of this will become more apparent as these new processes—now beyond the experimental stage in some countries—emerge as production processes in Britain. Already the friction welder built by the Association has attracted the interest of both welding machine manufacturers and producers of welded components. The next step will be to construct an electron beam welder, the plans for which have been put in hand.

A Pig in a Poke

ONE of the differences between the old time trick of selling a pig in a poke and the modern prepackaged bundle of goods is that the latter is often encased in a transparent wrapper. The purchaser is all too often left to guess at the actual quantity he is buying or else it is marked in the smallest type known to the printer.

The Weights and Measures Bill, introduced a year ago but dropped for lack of time and now to be introduced again this session, has been spread wide to cover a variety of prepackaged goods that will in the future have to have the weight printed on them. This will allow the consumer to make a more informed choice as between two articles by knowing the relative cost per unit weight. Thus the showy container of large size but holding only a small quantity of the product in an inner chamber will stand revealed for what it is.

The Bill has been cast wide but it may well lead to wider coverage yet. From weight to contents is but a step and indeed for many items the ingredients already have to be printed on the label. From ingredients to purity is the next stage and somewhere about here there arises the question of quality. In this country the consumer has several guides.

First of the guides to ensure acceptable minimum quality are the appropriate British Standards. A very large number of consumer goods have their Standard and a leaflet " A Guide to Dependable Goods " is available which quotes most of them. In certain cases goods have been awarded the Institution's " kite mark " which is the guarantee that they are made to the requisite standard. This November a " master " standard has been issued, BS 3456, which incorporates as sections several earlier standards for domestic electrical appliances. It will be used by the British Electrical Approval Board for Domestic Appliances as their yardstick. Section A1, now issued, deals with general requirements for heating and cooking appliances working at 250 V or less and is concerned with electrical and mechanical construction insofar as these affect safety, durability and reliability in service. Appliances incorporating a motor must also comply with Part B. To conform fully, appliances must also meet the standard of their special section as well as the general one. The mark of the Approvals Board is the guarantee that the appliance is up to the Standard.

In the second line of defence come the testing stations of the Gas Council and Electrical Development Association. Both issue lists of approved items which they have found by experiment to conform with the requirements. Similar lists are produced for solid fuel appliances by the Coal Utilization Council. The last also includes appliances that have been approved for use in smokeless zones.

A complaint that has been levelled at these bodies is that while they ensure that a minimum standard of quality is attained, they give no idea as to whether it is attained efficiently or of the comparative merits of the item. With the choice of domestic goods as wide as it is now, the purchaser is often in doubt, not as to the actual quality, but as to which particular appliance is best suited to his needs. This gap is filled to a large extent by the independent testing bodies which publish their findings; for example, the Consumer Advisory Council and its publication *Shoppers Guide*, and the Consumer Association Limited, who publish their results in *Which?*

These two bodies publish unbiassed reports of tests carried out on goods bought over the counter, giving such particulars as might allow an intending purchaser to assess how far any one would meet his needs. Indirectly they can have considerable influence on design in that an unfavourable report can influence intending purchasers away from the item in question and therefore affect manufacturers' sales. As a result they have often come in for criticism regarding the validity of the tests they apply. In general, however, their operations are welcomed by both sides.

Similar bodies exist in many other countries. In February of this year the Organization for European Economic Co-operation published a booklet *Better Buying through Consumer Information* which is a report of an international conference. The first half of the booklet is devoted to the findings under such section headings as comparative tests, quality marking, and labelling, while the remainder gives lists of the bodies, both national and international, that took part. With Britain's entry into the Common Market looming on the horizon, it will become increasingly important for the consumer to have some definite yardstick by which the products of other countries can be judged. This is particularly the case as concerns labelling; the wool content of a " wool " article in Britain is not necessarily the same as that of a " laine " or " de laine " article in France. The latter need only have 66 per cent wool to qualify for the label.

A problem that applies particularly to electrical apparatus is that the colour code of the wires is not the same for Continental goods as for the British Standard. In this country green is usually used to denote earth, but on the Continent green is the neutral lead. Thus it would be all too easy to misconnect a piece of electrical apparatus from abroad, perhaps with disastrous results. Purchasers will have to watch, too, the relative sizes of the pound and the kilogram.

Both the Labour and the Conservative parties have ideas for improving the protection of the consumer. The former produced their booklet, *Fair Deal for the Shopper*, first. This advocates the formation of a Consumer Council which would test products, challenge claims, supervise regulations examine contracts, and see that protective legislation was properly used. A small full time body was envisaged with trade panels for consultation.

Other proposals put forward include measures against exploitation by false advertising, misleading claims for products, sales of unsafe and poor goods, dishonest services and other malpractices. When tests proved that some commodity was harmful or potentially dangerous or of poorest quality, the Council would advise the Board of Trade to stop sales.

The Conservative booklet *Choice* appeared some whatlater and put forward somewhat different ideas. A central consumer council is rejected and instead an extension of the present Weights and Measures Inspectorate into a consumer protection service is proposed. Citizens Advice Bureaux would be enlisted to provide channels for information and complaints.

Consumer protection can be covered more or less adequately by legislation: consumer information cannot. Protection that an article conforms to safety standards is given when it carries the seal or mark of approval of a recognized testing body, working to official standards. If then it fails in service the consumer has legal remedy. No official standard can tell the consumer whether any one article is the right one for his particular needs; only comparative tests can do that. The continuance of such independent testing bodies is advocated in *Choice* with the proviso that if they should fail a government sponsored replacement would be needed. Their work should be officially registered but otherwise they would act on their own responsibility. Finally, however, as *Choice* says, " Only the individual can be sure that he is wise in his buying habits; the Government's job is to see that he is *able* to be wise."

British Standards Institution, 2 Park Street, London W1.
Consumer Advisory Council, Orchard House, Orchard Street, London W1 (*Shoppers Guide*).
Consumer Association Limited, 333 High Holborn, London WC1 (*Which?*).
Better Buying, from HMSO (4*s* 6*d*).
Fair Deal for the Shopper, Transport House, Smith Square, London SW1 (1*s* 10*d* inc postage).
Choice, Conservative Political Centre, 32 Smith Square, London SW1 (2*s*).

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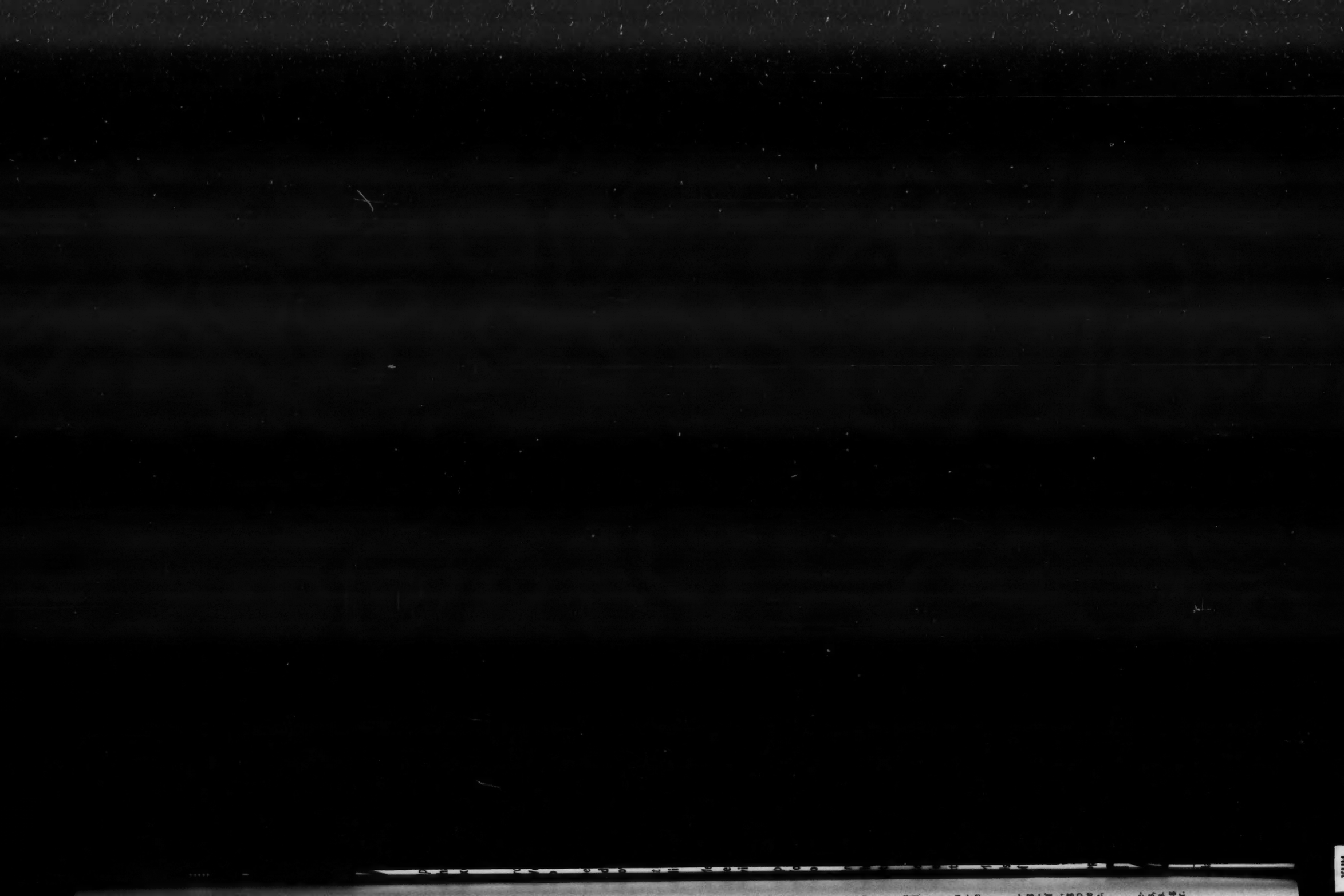
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